



Digitized by the Internet Archive
in 2015

<https://archive.org/details/b21913924>

INAUGURAL ESSAY
ON THE
PATHOLOGICAL CHARACTERS
OF THE
URINE,

AS INDICATING THE PRESENCE AND
EXTENT OF DISEASE;

SUBMITTED TO THE
**Medical Faculty of the University
of Edinburgh,**

IN CONFORMITY WITH THE RULES FOR GRADUATION,

BY AUTHORITY OF THE
VERY REVEREND PRINCIPAL BAIRD,

AND WITH THE SANCTION OF THE
SENATUS ACADEMICUS.

BY
EDWIN ADOLPHUS,
OF LONDON,

EXTRAORDINARY MEMBER OF THE ROYAL MEDICAL SOCIETY OF
EDINBURGH,

AND CANDIDATE FOR THE
DEGREE OF DOCTOR IN MEDICINE.

EDINBURGH :
PRINTED BY JOHN STARK.

MDCCCXXXVIII.

R34585

TO
JACOB ADOLPHUS, M. D.,
INSPECTOR-GENERAL OF ARMY HOSPITALS,
&c. &c. &c.

This Essay

IS DEDICATED
BY HIS AFFECTIONATE AND GRATEFUL
SON.

P R E F A C E.

THE Author of the following Essay has been induced to publish it, from the circumstance of its having been one of those which received the particular approbation of the Medical Faculty.

It is necessary, however to state, that, in order to render it more worthy of perusal, he has supplied several deficiencies, and considered some subjects more fully than in the original Essay, but its main characters are unaltered. He apologizes for bringing it out at so late a period, but this was caused by circumstances over which he had no control.

Appended to the Essay will be found a Report on Cases of Bright's Disease of the Kidney, illustrated by six coloured Plates. These additions will not, he trusts, be found to detract from its utility, if it should be found at all useful.

43, QUEEN STREET,
1st October, 1838.

ON THE
PATHOLOGICAL CHARACTERS
OF THE URINE,

AS INDICATING THE PRESENCE AND EXTENT OF DISEASE.

THE important additions which the Practice of Medicine has of late years received from a more careful attention than hitherto to the numerous derangements to which the urine is liable,—the satisfactory results which have been obtained by accurate experiments and observations on the varied conditions of this secretion in disease, and the necessity of such investigations to correct diagnosis and prognosis, are circumstances which sufficiently show that a constant examination of the state of this animal fluid is at all times of much advantage to the physician ; and the great variety, the extreme frequency, as well as the insidious nature and intractable disposition of some of these pathological conditions, render the necessity of this inquiry both obvious and urgent.

There is scarcely a disease, indeed, in the whole catalogue of nosology in which this fluid will not be found more or less altered from its healthy condition. In the *phlegmasiæ*, its deviation from that state is constantly, or almost constantly manifested. In these diseases too, which, though inflammatory, possess a specific character, such as rheumatism and

gout, both acute and chronic, this secretion has long been noticed as undergoing more or less alteration. In the varied forms of dropsy the same fact is not less obvious. In those morbid states of the system in which the lumbar portion of the spinal nerves appears principally affected, a corresponding derangement of the urinary secretion is commonly met with. In these proteus-like forms of disease, hysteria and dyspepsia, changes in the urine not less conspicuous are constantly brought before our notice.* In icterus this fact is also manifest. In pregnancy, the deviation of this fluid from its normal state is also generally observed. In gravel and calculus important changes in this secretion are invariably noticed. In the disease of the kidney described by Dr Bright, this circumstance is more particularly remarked. And in diabetes, so obscure, both in respect to its pathology and treatment, an extraordinary and unusual change is found to take place.

Without considering the physiology of the urine, or its chemical constitution in the healthy state, (the best account extant of which is that given by the late Dr Turner,) or describing the structure of the kidneys, or the manner in which this animal fluid is eliminated by these glands,—all subjects of much interest to the physiologist,—I shall proceed at once to treat of the pathology of the renal secretion, as it forms of itself a very extensive subject. To accomplish this properly, it becomes necessary to adopt some convenient arrangement, as a nosological arrangement is impracticable; and the following is accordingly submitted, as being perhaps less liable to objection than others, which have been formed with the same intention.

* Brett on Urinary Deposits, Medical Gazette for February 1836.

I. MORBID CONDITIONS OF THE URINE ARISING EITHER FROM AN EXCESS OR DIMINUTION OF ITS NATURAL INGREDIENTS.

<i>Excess.</i>		<i>Diminution.</i>
a. <i>Water.</i>		
Diuresis.		Dropsies.
b. <i>Urea.</i>		
Diabetes <i>insipidus</i> ?		Renal disease.
Hepatitis.		Cholera.
Fevers.		
c. <i>Lithic Acid.</i>		
Lithic Acid Diathesis	{ Fevers.	
	{ Rheumatism.	
	{ Gout.	
	{ Hepatic diseases.	
	{ Dyspepsia.	
d. <i>Earthy Phosphates.</i>		
Phosphatic Diathesis	{ Malacosteon.	Renal disease.
	{	
e. <i>Mucus.</i>		
Diseases of Bladder.		

II. MORBID CONDITIONS OF THE URINE PRODUCED BY THE ADDITION OF NEW PRINCIPLES EXISTING EITHER IN THE BLOOD OR IN THE NATURAL SECRETIONS.

a. <i>Principles found in the Blood.</i>		
Hæmaturia.	{ 1. Albumen,	{ Albuminuria.
H. renalis.	{ 2. Fibrin,	Bright's disease of the kidneys.
	{ 3. Hæmatosine,	Crisis of acute diseases.
H. ureterica.		Fevers.
H. vesicalis.		Gout.
H. urethralis.		Dyspepsia.

b. *In the Natural Secretions.*

4. Bilc 5. Caseum

III. MORBID CONDITIONS OF THE URINE OCCASIONED BY THE ADDITION OF NEW PRINCIPLES FOREIGN TO THE BLOOD.

a. *Principles generated within the system.*

- | | |
|----------------------|--------------------|
| 1. Sugar. | 5. Carbonic Acid ? |
| 2. Nitric Acid. | 6. Oxalic Acid. |
| 3. Purpuric Acid. | 7. Xanthic Oxide. |
| 4. Uro-benzoic Acid. | 8. Cystine. |

b. *Principles introduced from without.*

Derangements caused by the ingesta of certain substances, whether in the form of aliments or medicinal agents.

- | | |
|--|--|
| <p><i>α. Ingesta of Aliments.</i></p> <p>Citric Acid</p> <p>Malic Acid.</p> <p>Tartaric Acid.</p> | <p><i>5. Vegetable colouring principles.</i></p> <p>Alizarine.</p> <p>Rhabarbarine.</p> <p>Indigo.</p> <p>Hæmatoxyline.</p> |
| <p><i>β. Medicinal agents.</i></p> <p>1. <i>Simples.</i></p> <p>Iodine</p> <p>Chlorine.</p> <p>2. <i>Metals.</i></p> <p>Mercury ?</p> <p>Iron ?</p> <p>3. <i>Neutral salts.</i></p> <p>4. <i>Acids.</i></p> <p>Nitro-muriatic.</p> <p>Succinic.</p> <p>Hydrocyanic ?</p> | <p>6. <i>Colouring principles probably animalized.</i></p> <p>Cyanurine ?</p> <p>Melanie Acid ?</p> <p>7. <i>Odoriferous principles.</i></p> <p>Oleum Juniperi.</p> <p>——— Valerianæ.</p> <p>——— Allii.</p> <p>Castoreum.</p> <p>Narcotine ?</p> <p>8. <i>Alcohol.</i></p> |

IV. MORBID CONDITIONS OF THE URINE ARISING FROM SUBSTANCES MINGLING WITH IT BETWEEN ITS SECRETION AND EXCRETION.

- | | |
|---------|-----------|
| 1. Pus. | 2. Hairs. |
|---------|-----------|

V. DISEASES AFFECTING THE SECRETION AND EXCRETION OF URINE.

- | | |
|--|---|
| <p><i>a. The secretion.</i></p> <p>Ischuria renalis.</p> <p><i>b. The excretion.</i></p> <p>l. ureterica</p> | <p>l. vesicalis</p> <p>l. prostatica</p> <p>l. urethralis</p> <p>Enuresis</p> <p>Dysuria.</p> |
|--|---|

VI. URINARY CALCULI.

This arrangement will, I believe, be found to comprehend all the pathological states of the urine which are attended with characteristic symptoms. To consider all those found in the arrangement would far exceed the limits of an essay like the

present ; and I shall therefore confine my observations to the description of those derangements belonging to the first four sections.

I. MORBID CONDITIONS OF THE URINE, ARISING EITHER FROM AN EXCESS OR A DIMINUTION OF ITS SEVERAL INGREDIENTS.

a. *Water.*

The water of the urine, constituting as it does so great a proportion of this, as well as of other animal fluids, when it is above or falls below the natural standard, gives rise to disease.

Excess.—The watery portion of the urine is *increased* in hysteria and other nervous affections, while the other principles remain the same, or become much diminished. At other times, on the other hand, the increased flow of urine, or *diuresis*, is attended by an increased proportion of a natural ingredient, as of urea, which I have remarked in the urine of fevers, or of unnatural ingredients, as of albumen, as is exemplified at the commencement of granular disease of the kidney occasionally, or of sugar, as is observed in diabetes. In the first stage of fever, which is generally ushered in by rigors, the cutaneous transpiration being suppressed, the urine necessarily is more diluted. In that form of diabetes, denominated by some authors *diabetes insipidus*, the watery portion of the urine is much augmented. That, however, this kind of urine is essentially different from true diabetic urine is obvious from two circumstances ; viz. 1st, that no sugar is present in the former, and 2dly, this kind of urine is generally low in density ; but if it should even be high, this increased specific gravity is owing to the excess of *urea* present. The consideration of diabetes, therefore, does not belong to this place, as I consider all these cases mentioned by authors, as instances of the *diabetes insipidus*, to be merely cases of diuresis. The urine in diuresis is usually limpid and colourless, and its density, as already stated, almost invariably low, that is, varying from 1.001 to 1.010. Some authors, I am aware, are of opinion, that cases of this description are

very apt to terminate in *diabetes*, (a term which should be restricted to a saccharine condition of the urine,) and consider that there are cases of diabetes in which the urine is not saccharine.

Dr Cullen was rather doubtful whether he should admit the existence of this species, yet he informs us he had seen one case in which the urine was not saccharine. Of this description are the cases related by Mirabelli,* Bostock,† and other authors, the former of whom has stated that the urine in *diabetes insipidus* differs very little in its principles from healthy urine; and the case narrated by Dr Bostock, in which the density of the urine was found as high as 1.034, but did not contain any saccharine matter, is a true case of the *diabetes insipidus*, according to this author, but by some would be considered as a case of diuresis. In many cases this increased discharge of urine may be regarded as the effect of the insatiable thirst experienced by the patient, constituting *Polydipsia*. Of this, a good illustration occurred in the hospital during the winter in a young woman of the name of Chisholm, who was for some time supposed to be affected with diabetes; but as the urine was found to be only 1.001 in density, and to be devoid of any saccharine extract when evaporated, the supposition was abandoned. The term diabetes, then, being restricted to a saccharine condition of the urine, *diuresis*, upon these principles, would form the genus of which diabetes would be a species.

Diminution.—The water of the urine may, in the *second* place, be very much diminished below the natural standard, as occurs in those diseases accompanied with dropsy. We must, however, distinguish those cases in which the urine is simply diminished in quantity, while its composition and quality remain the same, from those in which there is a deficiency of the watery portion, as well as of some of the other constituents of this fluid. The former merely signifies scantiness of urine, and occurs in many diseases of very different character, whereas the latter implies a more serious derange-

* Duncan's *Annals of Medicine*, Vol. iii. 1799.

† Bostock in *Medico-Chirurg. Trans.* Vol. iii. 1812.

ment of the urinary secretion, and occurs in the varied forms of dropsy, especially in the renal dropsy, where, along with this diminution of the watery portion, other ingredients of this fluid, as the urea and salts, are also observed to be defective. In the different species of ischuria, with the exception of *ischuria renalis*, no diminution of the watery portion occurs, for they all arise from some mechanical obstruction in the urinary passages. In the various forms of gravel and calculus the proportion of water is diminished, whilst the quantity of the other ingredients is very much increased.

b. *Urea*.

The urea, which in healthy urine amounts to 30 parts per 1000 according to Berzelius, and 55.2 according to the experiments of Dr Christison,* may be either increased or diminished in quantity, and thus give rise to disease.

Excess.—When nitric acid is added to healthy urine, no crystallization occurs until the urine is concentrated by evaporation. When, however, the urea is increased, the effect is produced without previous concentration. The method I have employed to ascertain whether this principle is in excess, is that suggested by Dr Prout. A little of the urine is put in a watch-glass, and an equal quantity of pure nitric acid is carefully added to it, in such a manner that the acid shall subside to the lower part of the glass, from its greater specific gravity, and allow the urine to float above it. If spontaneous crystallization takes place, an excess of urea is indicated, and the difference of excess can be inferred near enough for practical purposes, by the greater or less time which elapses before crystallization takes place, which time may vary from a few minutes to two or three hours. Whenever the density of the urine is high, above 1.025 or 1.030, for example, the proportion of urea in common with the other principles is necessarily larger than natural, and in this case spontaneous crystallization will frequently take place on the addition of nitric acid. This concentrated state of the urine has been observ-

* Ed. Med. and Surgical Journal, 1829.

ed to occur in febrile and other disorders, and appears to depend, at least in most instances, on a diminished secretion of water only, being quite unconnected with any disease of the urinary organs.

In other instances, however, an excess of urea, as compared with the other ingredients of the urine, is actually present. This Dr Prout states he has observed in the urine of children and others depositing the phosphates.*

The cases in which I have observed this excess of urea, as indicated by the almost spontaneous crystallization produced by the addition of nitric acid to the urine in the manner above-mentioned, amount to eighteen in number, in five of which it was occasioned by a concentrated condition of this secretion, as I shall have occasion to show; but in the remaining thirteen, was caused by an actual excess of this principle, as indicated by the quantity discharged. This test of nitric acid, employed to ascertain whether the urea be in excess, requires care in its application; because the heat of the atmosphere being subject to variation, will cause an equal variation in the urine required for crystallization, even in identical portions of urine, according to Rees, who is of opinion that a much higher specific gravity than 1.025 or 1.030, as stated by Prout, may exist without presenting the property of becoming crystallized with nitric acid before evaporation; Berzelius having examined a specimen of urine of specific gravity 1.030, which, even when evaporated to three-fourths of its original bulk, failed to yield crystals on the addition of nitric acid.† The following table is intended to exhibit, in a condensed form, the cases in which the above phenomenon was observed on the addition of nitric acid to the urine.

* Prout on Gravel, Calculus, &c. 1821.

† Rees on the Blood and Urine, p. 84.

No.	Disease.	Characters of Urine.	Specific gravity.	Quantity in ounce.	When crystallization occurred.
1.	Febris, -	High-coloured, acid, with lateritious sediment,	1.029	24	Spontaneously.
2.	Ditto,	Ditto,	1.026	30	Nearly so.
3.	Ditto,	Ditto,	1.024	48	3 minutes.
4.	Ditto,	Ditto,	1.024	54	4½ minutes.
5.	Ditto,	Ditto, coagulable by heat and nitric acid,	1.027	24	7 minutes.
6.	Rheumatismus acutus,	Pale-lemon colour, clear, ammoniacal, -	1.034	Scanty.	Spontaneously.
7.	Ditto,	Brownish-red, turbid, rendered clear by heat,	1.027	54	5½ minutes.
8.	—chronicus,	Brownish-red, depositing the lithates, clear by heat,	1.025	60	4 minutes.
9.	Cyaniche laryngea, -	Deep-brown, depositing the lithates, clear by heat,	1.021	Scanty.	2 minutes.
10.	Morbus cordis, -	Very pale, clear, fetid, alkaline, -	1.027	18	Spontaneously.
11.	—hepatis, -	Very pale, depositing the phosphates, alkaline,	1.024	20	Nearly so.
12.	Hypochondriasis, -	Pale, turbid with sediment of lithate of ammonia,	1.028	Abundant.	Spontaneously.
13.	Sciatica, -	High-coloured, turbid, with phosphatic sediment,	1.030	54	4 minutes.
14.	Hypertrophica hepatis,	High-coloured, alkaline, with mucous cloud,	1.026	Scanty.	Spontaneously.
15.	Phthisis pulmonalis,	Rather pale, acid, clear, fetid, -	1.020	48	Nearly so.
16.	Bronchitis chronicus,	High-coloured, acid, turbid, clear by heat, -	1.018	Scanty.	Spontaneously.
17.	Gastrodynia, -	Pale, with phosphatic sediment, alkaline, -	1.024	42	Ditto,
18.	Dysenteria chronica,	Very pale, with sediment of lithates, -	1.022	40	12 minutes.

Note.—The excess of urea observed in the urine of the fever cases occurred in 3d and 4th during the cold stage, when the urine may be said to be more diluted, owing to the suppression of the cutaneous transpiration at that period; in the 1st, 2d, and 5th during the hot stage, and ceased to present the appearance in question when convalescence was fairly established

From the foregoing table, roughly constructed as it is, it therefore appears, that the urine in eight out of the whole number of cases had a greater specific gravity than healthy urine. Considering the average density in health to be 1.025, (or if the mean be fixed at 1.024, *at which I have estimated it*, from the examination of the urine of thirty men in comparative health,) the number of cases, in which this excess of urea was inferred from the increased specific gravity of the urine, combined with the effect produced by the action of nitric acid, will amount to ten. In cases 1, 2, 5, 10, 11, where the quantity discharged during the twenty-four hours was noted, and in which this spontaneous crystallization was observed on the addition of nitric acid to the urine, this effect no doubt resulted merely from a concentrated state of the urine, the quantity voided being in all *below* the natural standard ; but in six other cases in which the quantity was found on examination to be *above* the mean average, if reliance is to be placed on this test at all, the urea must have been actually present in excess. Of the remaining five, the quantity was not ascertained, but reported to be abundant only in one, and scanty in the other four ; on these, therefore, no stress will be laid ; but it is important to notice that in three of the latter spontaneous crystallization produced by the method above-mentioned, was observed to occur.

In connection with this subject, I may state, that the average density of the urine in health, although it has been variously estimated by almost every writer on the subject, may be fixed at 1.025, and the mean quantity discharged per diem, although similarly circumstanced, may be estimated at thirty-five ounces ; but both these points I shall have occasion to illustrate frequently in the course of this essay, and shall not advert to them farther in this place.

To return from this digression, it is important to remark that the case of acute rheumatism, in which the density of the urine was found to be as high as 1.034, and in which the above phenomenon was characteristically marked, presented a very concentrated state of this secretion, for the urine, although not accurately measured, was observed to be very scanty. The

proportion of cases of fever in which this excess of urea was inferred, amounts to five, and as this effect was noticed so often, that is to say, five times out of thirteen cases examined for another purpose, and cannot be explained by a concentrated state of the urine, if we except cases 1, 2, and 5, in which the quantity was small, I am inclined to think that an excess of urea is not an uncommon occurrence in the urine of persons affected with fever, but, at the same time, it is but candid to confess, that I leave it to my readers to judge whether any conclusions are to be drawn or not from so small a number of experiments, nor indeed would the author have adverted to the subject, were it not from a desire to induce some person more competent than he professes to be to direct their attention to these conjectures. The number of cases of rheumatism, both acute and chronic, in which the urine was examined with a different object in view, viz. to detect albumen, to which I shall allude in a subsequent part of this essay, amounted to eleven; and this excess of urea was remarked in two cases of acute and in one of chronic rheumatism, the latter having been previously alluded to, to illustrate an opposite fact, but the former of which I now mention to show, that neither in the other two cases could this effect been produced by a concentrated state of the urine, as it will be seen that in these, (No. 7 and 8,) the quantity of urine amounted to fifty-four and sixty ounces respectively.

I shall not say anything respecting the other ten cases, except, perhaps, the case of disease of the liver, as no inference can possibly be drawn from them; but this may be noticed, in as much as the urea has been supposed to be deficient in hepatic affections, more especially in hepatitis, by Dr Henry and Mr Rose; but Dr Prout, on the contrary, is of opinion, that, in this disease, there is generally an *excess* of this principle in the urine rather than a deficiency,*—a fact which perhaps receives some confirmation, from the circumstance of this excess having been observed in case 11 partaking of the nature of chronic hepatitis, but the urine, it may be said, was in a concentrated condition.

* Prout on Gravel, Calculus, &c. p. 11.

The diseases in which an excess of urea may be considered, however, pathognomonic, have been noticed by Dr Prout, who justly remarks, that they have often been, and, I would add, continue to be, confounded with other affections, particularly with that supposed form of diabetes which really has no existence,—I mean that to which the term of the *diabetes insipidus* has been applied. Thus the case related by Dr Bosstock,* to which I have previously referred in another place, when endeavouring to explain the impropriety of the term, or rather non-existence of the *diabetes insipidus*, improperly so denominated, with deference to so celebrated an authority, is, I conceive, to all intents and purposes,—as well as many others I could mention of this class,—not a case of diabetes, (for this term must be restricted to a saccharine condition of the urine, and to that alone,) but merely a case of *diuresis* produced by an excess of urea in the urine; for urine having a density of 1.034, which we are informed it had in this instance, if it did not contain any saccharine matter, must necessarily contain an excess of its solid constituents, and as the salts were not much augmented, I hence infer that the urea was in excess, to which its increased specific gravity is to be ascribed; and that this is really the case is obvious from the circumstance mentioned by this author, viz. that his patient was discharging six ounces and a half of this principle more than the natural quantity.† As, however, I may have occasion to advert to this subject in a subsequent part of this essay, I shall only mention at present, that the *diabetes insipidus* (for that is the disease with which an excess of urea in the urine has been most generally confounded) is not only a useless and inappropriate term, but, having really no existence, is an incorrect appellation, and apt to lead to very serious mistakes in practice. The excess of urea secreted by the kidneys in *diabetes insipidus* necessarily stimulates these glands, and more or less *diuresis* is the consequence of such excitement. The quantity discharged, therefore, within a given period rises on that account above the healthy standard, and may amount to five or ten pounds daily, but when it is very

* Prout on Gravel, Calculus, &c. p. 8.

† Op. citat.

abundant twenty pounds; for example the density of the urine will *not* be high although urea be in excess. I do not mean to assert, however, that, in every case of diuresis there is an augmentation of the proportion of this principle in the urine; but I do entertain the opinion, however, that, whenever this is the case, if permanent, diuresis is the effect. Should, however, this specific gravity of the urine be very high, 1.030 for instance, there can be no doubt as to the fact of an excess of urea, if the *quantity* at the same time be ascertained to be considerably above the healthy standard. This is what, therefore, constitutes diabetes *insipidus*? But we have several circumstances to attend to in forming a diagnosis between these morbid conditions of the urine in which an excess of urea is observed, from diabetes, and the following characters appear quite unequivocal. In the *first* place, as regards the physical properties of the urine, which for convenience are properly, I think, divided into the sensible, mechanical, and chemical, it may be remarked, that among the former the colour of the urine in these diseases, among which diabetes insipidus has been placed in the arrangement, does not present that characteristic pale straw-coloured (or rather yellowish green tint) observed in true diabetic urine. It is sometimes no doubt pale, as Dr Prout correctly remarks, but may also be high-coloured, and then exhibits somewhat the appearance of porter more or less diluted with water; and this variety not unfrequently takes place in the urine of the same person. In eleven of the eighteen cases in which this excess of urea was remarked, the urine was certainly high-coloured; in the remaining seven it was pale, and sometimes to a great degree so. The transparency peculiar to diabetic urine is not observed in these diseases, and its colour is often decidedly urinous; not so in diabetes. The taste, the last of the sensible characters, is in no instance saccharine; whereas, it is well known that in diabetes the urine always partakes of a sweet taste if the salts be not abundant.

Then as regards the hydrostatic properties of the urine in these complaints, the density is found to be a little above 1.020, and occasionally varies from 1.005 to 1.030, according

to Dr Prout; in diabetes, on the contrary, the specific gravity is seldom *below* 1.030. In respect to the chemical constitution of the urine in these affections, it is quite sufficient to remark that it contains no sugar. For the most part it is entirely free from sediment, except the mucous cloud of healthy urine, and the only property which it appears to possess is that of containing abundance of urea, so that on the addition of nitric acid crystallization speedily takes place. In diabetes, on the other hand, the urea, although not much, if it all diminished in its usual proportion, will never be procured from the urine in this method. "From the quantity of urea present it is very prone to decomposition, and soon becomes alkaline, especially in warm weather. There is almost constantly in these diseases a frequent and irresistible desire of passing water both by night and day. This desire is for the most part evidently excited by actual *diuresis*, or the increased quantity of urine; but frequently it cannot be ascribed to this cause, as the quantity voided at one time is by no means considerable; though in every instance that has fallen under my observation, the total quantity voided during any given time has appeared to be greater than natural."*

In the cases where I observed this excess of urea, the *quantity* was ascertained only in 13, and in 7 was found to be below the natural standard; the quantity of the remaining 6 was above the average.

In these diseases there is sometimes, Dr Prout informs us, a sense of weight or dull pain in the back; but this is by no means a constant symptom. There is also occasional irritation about the neck of the bladder, which sometimes extends along the urethra. The functions of the skin appear to be healthy, diaphoresis being easily induced. The pulse is not affected. The patient does not experience any remarkable thirst or craving for food, nor are the functions of the stomach or bowels impaired.

By keeping these points in view, those diseases in which an excess of urea may be considered in some degree characteristic are distinguished from diabetes.

With respect to the causes of this affection, they are very

* Prout on Calculous Disorders, p. 51.

various, having been observed to be induced by all those circumstances which give rise to albuminous urine, diabetes, and the deposition of the earthy phosphates, and with regard to the treatment, as there is a want of uniformity of symptoms, no uniform plan can be adopted. Sedatives, however, particularly opium, have been found advantageous. Concerning the termination of these complaints, some cases have been known to terminate in diabetes, others in a deposition of the earthy phosphates.

Diminution.—The urea may also be diminished in quantity or fall below the natural standard. The only disease in which a diminution of urea has been observed to be a characteristic symptom is granular disorganization of the kidney and malignant cholera, the former of which will be considered in detail in its proper place. Dr Christison, to whom the profession is indebted for the discovery not only of this important fact, but of others equally interesting in regard to this peculiar affection, as I shall have occasion to mention, has satisfactorily proved that the urea in Bright's disease of the kidney is not found in the usual proportion in the urine, but is considerably diminished below the natural standard. * The urine of every patient affected with this disease, subjected in analysis, was found to be materially deficient in this principle, the quantity contained being seldom so much as half the usual proportion, and occasionally not above a fifth, in other instances one-third. The urea found in one case was in the proportion of 20.4, in a second 16.9, in a third 11.6, whilst in a fourth the properties of this principle amounted to only 11.6. per 1000. Dr Charles Maitland has had the kindness to analyze, at my request, the urine of three patients affected with renal dropsy, the analysis of whose urine will be given in detail in a subsequent part of this essay: suffice it to mention in this place, that the urea in all of them was found defective. Thus in the first, this principle was found in the proportion of 23.2; in a second it amounted only to 9.7, and in the third, the quantity detected was found to be 18.5 per 1000. Now, healthy urine contains, according to Dr Christison's experiments, as much as 55.2 of urea with animalized acetates in 1000 parts.

* Ed. Med. and Surg. Journal, 1829.

In malignant cholera we are informed by the same author, that the urine in this disease, at least the first portions voided after suppression, was not only less dense than healthy urine, and impregnated more or less with albumen, but was deficient in its proportion of urea. In eight cases in which the density was ascertained, it was found to vary from 1.013, or 1.015 to 1.025, which was the highest observed, and occurred in a patient after suppression for the space of two days. * That the urea in these cases was not in its usual proportion in the urine is a fact which was indisputably established by the examination of the serum of the blood, when an opportunity presented itself, and the detection of the presence of this principle in it. “ In three cases in which the serum of the blood was examined after death, it was found to contain urea in appreciable quantity ; and in the serum of the man bled during reaction, and who had passed only a very little urine from the date of his attack, a very unusual proportion of that principle was found.”

“ In three other cases in which blood was drawn, in the one at the commencement of the collapse, in another before it appears to have approached, and a third when collapse was far advanced, the serum, when treated with nitric acid, still afforded distinct crystals of nitrate of urea.” The serum in these cases, it is important to observe, was high in density, owing to the excess of albumen, colouring matter and salts. The highest occurred in the man bled during the stage of reaction, being 1060.70. The condition of the urine in malignant cholera is not, therefore, in any respect dissimilar to that of persons affected with the renal disease ; but whether or not, this perverted action of the kidneys belongs to the reaction of cholera, or to a previously disordered state of these organs, is a point by no means certain, but, from the circumstance of so many of the fatal cases presenting more or less disease of these glands, Dr Craigie is inclined to support the latter opinion.

c. Lithic Acid.

In a pathological point of view, this acid is perhaps of

* Craigie on the Epidemic Cholera in Edinburgh, Ed. Med. Surg. Journ. 1832.

more importance than any other. Whilst Berzelius and most other chemists are of opinion that the lithic acid exists in the urine, at least in part in a free state, Dr Prout, from some experiments on the subject, believes that it exists in the urine in a state of solution at all ordinary temperatures, in combination with the ammonia, and that this fluid contains no uncombined acid at all.

The deposition of the lithates indicates generally an *excess* of lithic acid ; but I am not aware of any disease characterized by a diminution of this acid, although, as will be afterwards mentioned, the urine in diabetes has been supposed to be defective in uric acid.

Excess.—In healthy urine the lithate of ammonia (for that is the base with which this acid is usually combined) exists, as has been before stated, in such a proportion as to be held in solution at all ordinary temperatures ; but it must be manifest to every one, that even in apparent health the quantity of the lithate of ammonia is increased above the natural standard—a circumstance which seldom occurs, however, except when produced by errors in diet. This acid is separated from the urine under two distinct forms ; *first*, as an amorphous, or uncrystallized sediment, in which it is always in some state of combination, and *secondly*, in a crystalline form, and nearly pure. It is to the consideration of the former of these that I shall advert, the latter belonging more strictly to the subject of urinary calculi, and in doing so shall at the same time offer some remarks on the *Lithic Acid Diathesis*.

When the quantity of lithate of ammonia in the urine is increased above the natural standard, the excess is deposited as the urine cools, and thus constitutes the sediment in question. Such is an explanation of the phenomenon in its general and most simple form ; and the obvious conclusion to be drawn from it is, that the deposition of the amorphous sediments is indicative of an excess of lithic acid in the urine, at least most generally, although not always so, since a very slight excess of acid may be sometimes the cause of the deposition of these sediments. When urine containing lithic acid in excess is first voided it is commonly clear, and it is only after being allowed to stand for some time until its tem-

perature is reduced, that it becomes turbid, and that a sediment appears,—a fact easily explained by the greater solubility of the super-lithate of ammonia in hot than in cold water. A good test, therefore, although not so eligible as the nitric acid, for the presence of lithic acid in excess in the urine, is the application of heat, which will redissolve the sediment of lithate of ammonia, and the urine which was previously turbid will therefore be rendered as clear as when first voided. Thus we can distinguish the lithates from the phosphates, although the chance is very small of confounding the two. The most certain chemical test for the detection of the presence of lithic acid in the urine is the action of nitric acid, diluted with two or three times its bulk of water. Upon applying heat, the lithic acid is speedily dissolved; and if the fluid be cautiously evaporated to dryness, a pink stain is produced, much heightened in colour by the addition of caustic ammonia in small quantity, a coloration produced, as is well known, by the generation of *purpuric acid*, or the *purpurate of ammonia*, according to the opinion adopted as to the presence or not of lithic acid in a free state in the urine.

The opinion entertained by Dr Prout, viz. that the acidity of recent urine is owing not to the presence of free acid, but is occasioned by supersalts, is, I think, the correct one, from the fact mentioned by Dr Turner,* “that, on the addition of hydrochloric acid to recent urine, minute crystals of uric acid subside slowly from a state of solution, but, if no free acid be present, an amorphous sediment is obtained, an experiment which I have tried with the same result in two instances.” The lithates then are best distinguished from the phosphates by the action of nitric acid.

The exciting causes of the *lithic acid diathesis*, or the presence of an excess of lithic acid in the urine, are of three kinds; *a.* Simple errors in diet, to which I have before adverted to. *b.* Unusual or unnatural exercise, either bodily or mental, particularly after eating, and the want of proper exercise at all other times; and *c.* Debilitating circumstances.

With regard to the first of these it has been observed, that an unusually heavy meal, especially of animal food, or

* Elements of Chemistry, Ed. 5. p. 1003.

of bread, is invariably followed by a deposition of lithate of ammonia from the urine. An abrupt or decided change in the time of partaking food, such, for example, Dr Prout mentions, as dining at an earlier hour than usual, or eating supper, (to which the person is not accustomed,) will frequently produce the same effect. The substance most apt to produce a deposition of lithate of ammonia are, animal substances in general, and more especially heavy, unfermented bread, or compact, hard-boiled fat dumplings or puddings. With respect to the second, of the exciting causes mentioned by Dr Prout, it has been remarked, that horse exercise is apt to produce a turbid state of the urine, in those who are unaccustomed to it. Exercise taken immediately after a principal meal, whether mental or bodily, has been noticed to be almost invariably followed by a deposition of the lithate of ammonia from the urine, and the want of active exercise, on the contrary, after a certain stage of the digestive process has been completed, is frequently succeeded by the same event. Among the third of the exciting causes, viz. *Debilitating circumstances*, certain conditions of the atmosphere, depressing passions of the mind, inordinate mental or bodily fatigue, long fasting, &c. are often followed by the deposition in question from the urine.

Having now considered the principal circumstances which, independently of *actual disease*, seem capable of producing a sediment of lithate of ammonia from the urine, I shall, without entering upon the consideration of their nature and mode of operation, proceed to describe after Dr Prout the amorphous sediments observed in the urine of persons as indicating diseases.

These amorphous sediments are of these kinds :

1. Yellowish or nut-brown.
2. Reddish-brown or lateritious.
3. Pink sediments.

1. *Yellowish or nut-brown sediments.*

Consist essentially of lithate of ammonia, tinged with the colouring principle of the urine, but usually contain more or less of the phosphates, and sometimes a little of

the lithate of soda. Children are very liable to this form of sediment. This class of sediments may be termed the *sediments of health*, if the term may be allowed,—being such as are produced by errors in diet in the urine of healthy, or, I should rather say, comparatively healthy persons, or in that of slightly dyspeptic individuals. As far as my own observation allows me to offer an opinion on the subject, I should say that this sediment is only observed in the urine of healthy persons when produced by errors in diet, and the other circumstances above-mentioned, so that the individual, although not complaining of any urgent symptoms, is nevertheless not in full health. But whether this be the case or not, certain it is that this sediment is almost constantly the forerunner of gravel or calculus, in all who labour under such a susceptibility, and, indeed, has been observed to alternate in the urine of the same person with the crystallized sediment or *gravel*.

2. *Reddish brown or lateritious sediments.*

These sediments vary in tint from nearly white to a deep brick-red or brown, and consist of lithate of ammonia or of soda, tinged with a large proportion of the colouring principle of the urine, with more or less of the purpurates of ammonia and soda; sometimes also they contain a small proportion of the earthy phosphates. In general the deeper the tint, and the more approaching the brick-red colour, the more of the lithate and purpurate of soda they contain. This is the form of sediment so constantly observed in the urine of persons labouring under fever, and the presence of these purpurates indicates the secretion, therefore, of nitric acid by the kidneys, which always shows feverish or inflammatory action. They owe their peculiarity of tint to the colouring matter of the urine, which is secreted on such occasions, in common with all its other principles, more copiously. The urine is high-coloured, being of a deep-red or brown colour, and its density is high in such cases, as stated in a former part of this essay. In affections of the liver, this sediment I have observed in a greater degree, and in a more decided form, and in the greater number of cases of acute rheumatism,—indeed, I may say nearly in all, amongst

the patients admitted into the Royal Infirmary under the charge of Dr Christison, whilst I was officiating as clinical clerk, the urine presented the sediment in question. In gout it is also strongly marked. This form of sediment, like the previous one, is redissolved by heat, and is thus distinguished from the phosphates, although, as already stated, there exists very little chance of confounding the two.

3. *Pink sediments.*

Like the two just mentioned, these sediments consist essentially of the lithate of ammonia, but differ from them in being almost devoid of the colouring matter of the urine. They are, like the former, observed in the urine of persons labouring under affections of the liver; and in the urine of the hectic they are well marked. As the consideration of the lithic acid in the crystallized form does not belong strictly to this place, I shall, according to the arrangement, next treat of the Earthy Phosphates, since, as I am not aware of any disease characterized by a diminution of lithic acid; for although it has been stated that diabetic urine is defective in this acid, the latest experiments by Mr Kane * on diabetic urine, prove, I think, as he correctly remarks, that the circumstance of the one acid not having been found in the urine in this disease, depends merely on the great state of dilution of that fluid, and on the small quantity (only about 1 part per 1000) in which this animal acid is found in healthy urine, an opinion in which Berzelius appears to coincide.†

d. *Earthy Phosphates.*

The earthy phosphates like the lithates may be either increased or diminished in quantity, and thus give rise to disease.

Excess.—The deposition of these salts from the urine does not, however, as in the former case, indicate an excess of the acid with which the base is combined, for, on the contrary, if we attend to the chemical phenomena which produce the phosphatic sediments, we shall readily perceive that the phosphoric acid is actually diminished in quantity. There is in

* Dublin Journal of Medical and Chemical Science, Vol. i. 1832

† Traité de Chimie, traduit par Me Esslinger, Vol. vii. p. 408. 1833.

such instances a diminished or suspended action of the usual acidifying powers of the kidneys, and the formation, instead of lithic acid, of a greater quantity of alkaline matter than natural, as urea, (equivalent to ammonia, lime, magnesia;) the salts, therefore, with which it is usually associated are converted into neutral or subsalts, and are precipitated, thus giving rise to calculous concretions, whether of the di-phosphate of lime, or the ammoniaco-magnesian phosphate.

The sediments in question consist invariably of a mixture of the phosphate of lime, with the triple phosphate of magnesia and ammonia. Like the lithates they appear in the urine under two distinct forms, viz. in an *amorphous* state, and, secondly, in the *crystallized* form. The first of which will only be considered in this place, as the latter belongs more strictly to the subject of urinary calculi.

Phosphatic Diathesis.

“ A deposition of the earthy phosphates has been long observed to be attended with very distressing symptoms. These consist in great irritability of the system, and derangement of the chylopoietic viscera in general. There is a sallow haggard expression of countenance, and, as the disease proceeds, symptoms somewhat analogous to those of diabetes begin to appear, and the disease, if not speedily checked, seems capable of ending fatally.

The urine is pale, and is voided in greater quantity than natural, and by day in very profuse abundance, and in this case is of very low density, 1.001 or 1.002. At other times it is voided in less quantity, and its specific gravity is proportionally higher, but is seldom very high, that is, surpassing 1.025. In the former case the morbid condition of the urine constitutes one of the forms of *diuresis* in which the *increased* flow of urine is not *constant*, but takes place at certain times only, either spontaneously, or from the slightest exciting causes : so that, upon the whole, the quantity voided is generally greater (often much greater) than natural. In the former instance it is generally pellucid and colourless, and deposits no sediment; whilst, in the latter case, it is sometimes opaque when passed, and always, after standing for a greater or less time, deposits a most copious precipitate of the mixed phosphates,

in the state of an impalpable powder. In all cases the urine is extremely prone to decomposition, becomes alkaline by the evolution of ammonia, and emits a most disgusting smell.”* Among the causes of this complaint which may be either general or local, but which partake, however, for the most part, of both characters, it may be mentioned, that the greater proportion of cases were distinctly traced by Dr Prout to *some injury of the back*, having arisen for the most part from a fall from a horse, in which the person has received a violent general concussion of the spine, and often at the same time some local injury about the back. It is a very old observation, that injuries of the back produce *alkaline urine*, and holds in other animals as well as man. Thus, jaded and worn-out horses have frequently been observed to secrete great quantities of lime in their urine, and the same has been observed to take place in the urine of dogs, particularly of the sporting kinds; and in both these instances Dr Prout† thinks it probable, that the circumstance is connected with some strain or injury of the back by over-exertion or other causes. Among the local causes may be mentioned generally some irritation about the bladder or urethra, especially when operating constantly for a considerable length of time,—as for example any foreign substance introduced into the bladder, and producing irritation of that organ, including all sorts of calculi under certain circumstances; the retaining of a bougie or catheter in the urethra; strictures of the urethra in some rare cases, and in peculiar constitutions; all which, and many other similar causes, are capable of producing, in a greater or less degree, a condition of the urine more or less resembling that above described, and readily depositing the phosphates. Thus it has been long known that any foreign substance introduced into the bladder almost invariably becomes incrustated with the phosphates, and not with the lithic acid.

With regard to the proximate cause of this form of disease, Dr Prout supposes it to consist, as already stated, in the formation, instead of lithic acid, of a greater quantity of alkaline matter than natural.

* Prout, op. citato, p.35.

† Prout, op. cit.

In *Malacosteon* it has been observed by some authors, that a sediment of the phosphate of lime takes place from the urine. In a remarkable case of *mollities ossium* detailed by Dr Hosty, * the author remarks that the urine was observed to contain a quantity of this deposit, and correctly advances the opinion, that this sediment was the earthy matter that gives the bones their solidity and hardness. In the extraordinary case of Madame Supiot, described by M. Morand, † the sediment in question was also noticed in the urine. Other writers have also mentioned this circumstance. ‡ This sediment, it is important to observe, always corresponded in quantity with the bending of the bones, and, upon being analysed, was found to consist of phosphate of lime, and shortly after its appearance in the urine it was remarked that the bones began to soften, to bend in various directions, and to produce remarkable distortions. §

Diminution.—The earthy phosphates may, on the other hand, be very much diminished in quantity, or be found altogether absent, as is well exemplified in the renal disease. In the urine of persons affected with this complaint, Dr Christison states that the insoluble earthy salts are always very deficient, and sometimes entirely wanting.

Before concluding this part of the subject, it may not be improper to mention the characters by which the phosphatic deposits may be distinguished from mucus on the one hand, and the exceedingly pale lithates on the other, although there is very little chance of confounding them with the latter. Whenever a white or pale fawn-coloured deposit takes place from the urine, insoluble in caustic potass or soda, and completely soluble in hydrochloric acid, or nearly so without effervescence, that deposit is of the phosphatic kind. If, in addition to this, we find that the muriatic acid solution, when treated with just sufficient ammonia to render its reaction only very slightly acid, gives an abundant precipitate with oxalate of

* Philosophical Transactions, Vol. xlviii. 1754.

† Mémoires de l'Académie, 1753.

‡ Vide Medical Observations and Inquiries, Vol. v. Gooch's Surgery, Vol. i.

§ Allan's Surgery, Vol. ii. 1821.

ammonia, and the clear fluid separated from the precipitate by filtration is not affected by the addition of caustic ammonia in excess, the salt is exclusively phosphate of lime. * From *albumen*, urine containing the phosphatic deposits is distinguished by the addition of a drop or two of nitric acid, which, when added in this small quantity, renders the albumen more distinct, whereas the phosphates are dissolved. The precaution necessary to be adopted in this experiment is, not to use an excess of acid, as in that case the same effect will be produced on the albumen. In connection with this subject it may be mentioned, that urine, on being brought nearly to the temperature of ebullition, frequently presents a deposition of the phosphates,—a circumstance which has been explained by the fact, that the urea is decomposed in that case, giving rise to carbonate of ammonia. But Mr Brett, from some well conducted experiments on this subject, is of opinion that the phosphatic deposits in such cases are produced by the evolution of carbonic acid gas, and not by the formation of carbonate of ammonia resulting from the decomposition of urea and other animal matter. From the observations he has made, he is inclined to think that carbonic acid does exist in healthy urine, but then the experiments of Berzelius and Wöhler are opposed to this opinion. The phosphate of lime, Mr Brett further supposes from his experiments, is capable of being held in solution by carbonic acid, and it is by the evolution of this gas, as before stated, that the phenomenon produced by heat is produced. †

e. *Mucus*.

This substance, which is a secretion from the mucous membrane of the bladder, is always deposited even from healthy urine upon cooling, although in small quantity. It is most probable that the mucus is not in a state of solution in the urine, but only suspended through that fluid in a state of exceedingly fine division. When urine is first voided the mucus cannot be perceived, in consequence of its power

* Brett on Urinary Deposits, 1836. † Ibid.

of refraction being about the same as that of the fluid through which it is diffused. When, however, the latter cools, the mucous particles cohere, become increased in density, and consequently in refrangibility. The mucus of the urinary bladder is not precisely similar to that secretion as found on other mucous surfaces, although they all, indeed, have one physical property in common, viz. that of viscosity. The mucous deposition from healthy urine, although inconsiderable in quantity, hardly leaving, indeed, an appreciable residue during filtration, unless a very considerable quantity of urine be employed, is liable to be very much *increased* in disease ; then it is that the deposition takes place, for the most part, before the urine is evacuated from the bladder ; consequently that fluid will be found turbid, and sometimes even ropy at the moment of its emission. If urine of this character be allowed to stand for a few hours in a tall glass vessel, a very abundant opaque deposit will take place. This deposit is ropy and tenacious, and devoid of the yellowish green colour which is so characteristic of the purulent urinary deposits to be hereafter described. When collected upon a filter and washed, it appears semi-gelatinous from the absorption of water, is somewhat less opaque, and sometimes, from its exceeding tenacity, may be drawn out into threads. When allowed to dry on the filter it shrinks considerably, and assumes the character of a yellow varnish. If it be then moistened with water, it regains its former pulpy appearance and viscid character, and will be found to be soluble in caustic alkali, and, to a certain extent also, in acetic acid. It is sometimes found associated with a considerable quantity of phosphate of lime ; at other times, however, the proportion of the earthy phosphatic salt is inconsiderable, and in some cases the urate of ammonia is found in combination with the mucous deposit.*

In a pathological point of view, this mucus is of the utmost importance, especially when the urine deposits the phosphates ; in which case the mucous membranes, particularly of the bladder, are usually in a high state of irritation or actual disease. In such cases, a large quantity of an unnatural adhesive mu-

* Brett, op. citato.

cus is secreted, which becomes intimately intermixed with the earthy matters, and, by acting as a sort of cement, renders them more liable to adhere together and form concretions.

Mr Brett has described a peculiar substance, which he considers to be a species of mucus, having observed it in several instances, more particularly where the urine has deposited that form of lithates which is either so pale as to approach closely in physical character to the phosphate of lime, or accompanied with only a very small proportion of the colouring matter of the urine, giving it a yellowish or very pale fawn-colour.

He observed the urine thus rendered turbid by the deposit in question to clear entirely by the application of heat, even below the boiling point of water, and afterwards to become again turbid when brisk ebullition was kept up, although not to the same extent as before. When a drop or two of concentrated nitric or muriatic acid was added to this turbid urine, it became in no degree clearer, which showed it not to be the phosphate of lime, and that it was not albumen was proved by the action of nitric acid on such urine as soon as it was voided, whilst perfectly clear, when no turbidity was observed.

Excess.—It is hardly necessary to mention that the mucus is much increased in quantity in diseases either of the bladder or kidneys. With regard to the chemical tests for the detection of the presence of mucus they are uncertain, owing to its approaching pus so nearly in its characters.

The subacetate of lead occasions a copious white precipitate, when dropped into fluids highly charged with mucus. Nitrate of silver also occasions a precipitate under the same circumstances. I know of no disease characterized by a diminution of mucus in the urine. As the other natural ingredients of the urine, as the *lactic acid*, *sulphates*, *muriates*, &c. have not, I believe, been found altered in their usual proportion in disease, I shall, according to the arrangement laid down, next proceed to consider these morbid conditions of the renal secretion belonging to the next section.

II. MORBID CONDITIONS OF THE URINE PRODUCED BY THE ADDITION OF NEW PRINCIPLES, EXISTING EITHER IN THE BLOOD OR IN THE NATURAL SECRETIONS.

a. *Principles found in the Blood.*

The blood itself may be discharged along with the urine, and thus give rise to that pathological condition of the urine denominated *Hæmaturia*, or this fluid may contain the *albumen*, *fibrin*, or *hæmatosin* separately.

a. *Hæmaturia.*

Blood passed by the urethra may be derived either from the kidneys, ureters, bladder, or the urethra, constituting separately the different species of this complaint, to which the term of *H. renalis*, *ureterica*, *vesicalis*, and *urethralis*, have been respectively applied. *Hæmaturia* may exist either as an idiopathic or symptomatic disease, but is to be regarded generally as symptomatic of some local affection. Thus the presence of a calculus in the bladder will give rise to this symptom; in the renal disease, also, not only the albumen, but blood itself is frequently observed to be discharged along with the urine.

In scurvy, too, when blood has been effused from the exhalent arteries into the cellular membrane, under the skin, and also into the bowels, the renal capillaries allow the blood to escape with the urine; and, in some instances, the secreting vessels of the kidneys have been known to pour out red blood, without any direct evidence of the existence of a scorbutic diathesis. “A discharge of blood seldom takes place from the ureters, unless from the previous irritation of *calculi*; they have become highly vascular, and then suffered injury. A discharge of blood from the urethra frequently arises from the lodgement or passage of a calculus, and also sometimes occurs from the use of caustic in stricture, from the forcing a passage through a stricture, or the laceration of some part of the canal. It is not an uncommon occurrence in the inflammatory stage of gonorrhœa, particularly during the violence of chordee; and is generally the first consequence of

violent contusion of the parts. Hemorrhage from the bladder arises from a diseased state of that viscus.”*

SEMOGRAPHY.—*H. renalis* is frequently preceded or attended by pain or sense of fulness in the lumbar region, although, if the blood passes by the capillary arteries, this may not always be observed; but if the loins should have previously been injured by external violence, the diagnosis between this and the other species will not be difficult, and if, from the previous history of the case, the probable existence of renal calculi be inferred, the appearance of blood will at once be referred to its proper sources. In *H. ureterica*, when the bleeding takes place in consequence of a stone passing down, attentive examination of the symptoms will generally remove any doubt. *H. vesicalis* is, according to Mr Howship, not very difficult of diagnosis. In *H. urethralis* the hemorrhage either comes in or continues independent of the act or desire of discharging the urine; the blood is also pure and unmixed with the urine, and on standing forms a coagulum, bearing a just proportion to the serum, as in healthy blood.†

TREATMENT.—As *Hæmaturia* always indicates some morbid affection either of the kidney, ureter, bladder, or urethra, those curative means best calculated to remove the disease which induced it must be employed. When the hemorrhage takes place from the mucous membrane of the bladder, astringents, such as the *Arbutus uva-ursi* and the *Tinctura muriatis ferri* have been found useful; but when, however, blood effused within the bladder in quantity forms a coagulum, surgical aid then becomes necessary for facilitating its dissolution and removal, as the presence of a large coagulum within this viscus is apt to be followed by *ischuria renalis*.

The appearance of blood in the urine is so characteristic that it can hardly possibly be mistaken; if in minute quantity, it will merely impart to this fluid a scarlet blush. It might, however, be confounded with the deep lithates which I have sometimes observed to give to the urine a similar appearance, particularly if the pink sediments be mixed with a large quan-

* Howship's Practical Treatise on most of the important complaints affecting the Secretion and Excretion of Urine, &c. p. 52, 1823.

† Howship, *Ibid*.

tity of mucus. This mistake I have more than once committed. The application of heat, however, without producing coagulation, which always takes place when blood is present, immediately convinced me of my error. Urine containing blood may also, in some instances, be confounded with bilious urine. But of this in another place.

β. Albuminuria.

I shall at present consider the presence of albumen in the urine, first, as it occurs occasionally in diseases of very different character, before alluding to the presence of this principle in the urine as indicating Bright's disease of the kidney.

Cotugno* appears to have been among the first who noticed in some diseases the coagulability of the urine; but Mr Cruickshank † first turned the attention of the profession to the presence of albumen in the urine as indicating the presence of disease. He remarks that in idiopathic dropsy, and several diseases with increased action of the arterial system, the urine often contains the coagulable part of the serum, which may readily be detected by the nitrous acid or by heat; and, after entering upon the consideration of the composition of the urine in health, adds, "that nitrous acid, when added to healthy urine, produces a slight effervescence, and gives it more or less of a reddish colour, but produces no precipitation; but, that in some diseases, however, particularly general dropsy or anasarca, this reagent, when dropped into the urine, produces a milkiness, and in some instances a coagulation, similar to what would take place if added to the serum of the blood; that the corrosive sublimate also in some degree coagulates dropsical urine, but that it has no immediate effect on healthy urine, and that in dropsy the general disease may readily be distinguished from that depending on morbid viscera, by attending to the effects produced on this fluid by nitrous acid, and the corrosive muriate of mercury, for that in dropsy proceeding from diseased liver and other morbid viscera, the urine does not coagulate either by the nitrous acid or heat." The diseases in which the urine is found to be more or less

* Vide Note A.

† Experiments on Urine and Sugar, in Appendix to Rollo on Diabetes, p. 443. 1797.

impregnated with albumen are numerous, but must not be confounded with that affection shortly to be described, in which the presence of this principle in the urine is the characteristic symptom ; but before considering these it may not be improper to offer a few observations, which, from some attention to this part of my subject, I may be permitted to make, on the presence or absence of albumen in the urine in health. While most chemists exclude it from among the ingredients of healthy urine, Henry and Brande are of opinion, that it does enter into the composition of this secretion.

The urine, in common with the other animal fluids, probably contains this principle, but in so minute a proportion that its presence can only be detected by corrosive sublimate,—the other reagents not being able to discover a trace of it. I have had many opportunities of observing the effect produced on the healthy urine by corrosive sublimate, and perhaps may be allowed to state the result of these trials, as they hardly deserve the name of experiments. On adding a drop of a saturated solution of corrosive sublimate to urine, in which the presence of albumen was not cognizable by the usual tests employed for the detection of the presence of this principle, a dense flocculent precipitate was sometimes observed, but almost invariably turbidity was produced, differing in no respect from that indicating the presence of albumen ; and this phenomenon was remarked both in the urine of healthy individuals, and in that of the different patients in the Royal Infirmary, whenever the trial was made. But it is important to mention that in these cases it was not accompanied by a reduction in the natural density of the urine,—a result which accords with the accurate experiments of the late Dr Gregory, who found, that, in 480 trials, corrosive sublimate very generally produced the same effect on healthy urine. That condition of the urine, therefore, in which it is coagulable by the bichloride of mercury is quite compatible with health.

In some cases this precipitation of healthy urine by corrosive sublimate is connected with slight derangements of digestion, which I have observed in many instances ; but this was in no case better illustrated than in the case of a man in

the Royal Infirmary of the name of Reid, affected with dyspepsia, the urine of which patient was almost invariably precipitable by this reagent, but was never found coagulable either by heat or nitric acid; and although the density of the urine of this individual was below that of healthy urine, being about 1.010, 1.012, 1.016, still this circumstance is easily explained, when the quantity (which was generally above the healthy standard) is taken into consideration.

Sometimes, on the other hand, the urine of persons otherwise in good health, I have found to be *coagulable by heat*, and it has, on inquiry, been found generally to have been occasioned by certain articles of diet, such as pastry, and in my own person it has occasionally been artificially produced by taking coffee, a highly azotized species of diet; but in this, as in the former class of cases, it was not only not accompanied with a reduction of its average density, but the appearance in question was transient, and disappeared on the next day. The cause of the precipitate produced in healthy urine by *corrosive sublimate* has been ascribed by Berzelius to the absence of free acid in the urine, but in the trials now mentioned, the urine was found to be almost invariably acid. May we not, therefore, attribute the phenomenon in question to the decomposition of the bichloride which is converted into calomel? As it is not improbable that the same effect is produced by this reagent on *mucus*, it becomes rather a difficult question to say what proportion consists of albumen. On the whole, then, if this principle does really exist in healthy urine, it is probably in one of these modified forms to which Dr Prout has applied the term of merorganized or incipient albumen.

Dr Prout has been at much pains to show that the albuminous matter present in the urine frequently more resembles chyle than blood, and the cases which he has detailed appear to support such an opinion; but as there is no chemical test which will enable us to distinguish the albuminous matter of the chyle from that of the blood, and as the point in question must not be considered as established on the evidence of the senses only, the matter remains *sub judice*. That, however,

the albumen is actually derived from the blood in most, if not in all cases, has been satisfactorily proved by the experiments of Dr Christison, on the urine in the renal disease, when the blood was found deficient in its usual proportion of this principle. The examples of *chylous urine* (for that is the term by which urine rendered albuminous by chyle is known) detailed by Prout, I consider as cases of *caseous urine*, or urine containing the principle *caseum*, a subject to be subsequently discussed. Dr Prout, however, does not deny that the urine may not sometimes be rendered albuminous by the serum of the blood.

The diseases in which the urine is found to be more or less impregnated with albumen are, as I have already stated, numerous, and are to be distinguished from the *renal disease*, as they differ from it in many essential points, as I shall have occasion to show. An albuminous impregnation of the urine occurs very frequently upon the crisis of fevers; but in these affections, the sediment or precipitate is tinged more or less decidedly, either of a pink or a dull red colour, according to Mr Howship,* and the urine, as is well known, is high-coloured, although pale in the cold stage." In the first stage, which is preceded by rigors, the cutaneous transpiration being suppressed, the urine necessarily is more diluted, or has its watery portion in excess, as I have before explained, for a very obvious physiological reason; but when the febrile symptoms increase in severity, with heat and quickness of the pulse, the urine then becomes high-coloured, but no sediment is observed in it. † " Its free acid diminishes in proportion as its colour deepens, and now it is found to be precipitable by the bichloride of mercury, which is not produced unless the urine be sufficiently acid; as the fever advances, the urine is found to be more impregnated with albumen, as alum occasions a precipitate, and, towards the termination, it is found coagulable by nitric acid, which indicates an increase of the quantity of albumen. At the resolution of the disease, the free acid suddenly reappears in the urine, which is much

* Op citato.

† Traité de Chimie traduit par. M. Esslinger, Vol. vii. p. 402.

clearer, but becomes turbid when its temperature is reduced.* This condition of the urine has been supposed to indicate the crisis of fever. In intermittents the urine presents in each paroxysm these three characters: An attack of *gout* is sometimes observed to be attended with a flocculent pink-coloured sediment in the urine of albumen. Albuminous deposits in the urine may occur from temporary irritation at the neck of the bladder, and also from enlargement of the prostate gland according to Mr Howship.†

At the period of resolution of *acute diseases* the urine acquires the property of becoming coagulable by heat and precipitable by nitric acid, according to the late observations of Dr Martin Solon,‡ who has remarked that such urine, whether coagulable or precipitable, indicates a crisis.

1. “Coagulable critical urine contains albumen, and sometimes also partakes of the nature of the precipitable.”

2. Precipitable critical urine, which is more frequently observed than the other species, may be distinguished by the cloud that is immediately produced on the addition of an acid, especially the nitric. This cloud is soluble in an excess of acid, and appears to be composed, he remarks, of urate of ammonia, modified by the morbid condition which gives rise to it.

3. Precipitable critical urine cannot be confounded with ordinary turbid urine (*urina jumentosa*); for nitric acid, instead of precipitating the latter, renders it clearer than it was before its addition. The urine is very rarely precipitable at the outset of acute diseases. When nitric acid does act at that period, the cloud is small in quantity, and indicates nothing; if it be considerable the disease may be expected to subside before its complete developement. Acute diseases rarely reach their period of resolution without the urine becoming precipitable by the acids.

4. Coagulability of the urine, especially, is evident at that period alone, and ceases to exist when convalescence is fairly

* *Traite de Chimie* par Berzelius traduit par M. Esslinger, Vol. vii. p. 402.

† *Op. citato.*

‡ *De l'Albuminurie ou Hydropisie causé par la Maladie des Reins.* 1838.

established. M. Solon has given a table exhibiting the results on which these several propositions have been founded, from which it appears that of 78 cases of acute diseases, there exist 19 which form exceptions to this law—15 from the want and 4 from the presence of albumen.

Before, however, concurring in these propositions, it would be necessary for some one to repeat these experiments.

I have now shown that the urine in many diseases is more or less impregnated with albumen, and have accordingly adopted the term *albuminuria*, used by M. Solon to express this condition of the urine as it occurs in these complaints, but do not apply it to express that morbid lesion of the kidney which is always found to coexist with this condition of this secretion, but merely to express the fact that the urine contains coagulable matter. In the diseases in question the urine has not been proved to be deficient in urea, nay, I have observed the urine to contain albumen in a case of fever, in which this principle was *in excess*, neither have the saline contents been shown to be diminished in quantity. The density, too, of the urine is not low, as in the renal disease, (for in the case in which the urea was found to be in excess and the urine contained albumen,)* the specific quantity of this fluid was naturally found higher than natural. Lastly, the appearance in question is, as in the cases in which an albuminous impregnation is produced in the urine in cases of dyspepsia, only transient, and ceases to be coagulable when convalescence is established. The history of the case, the manner in which the disease has been induced, and other circumstances, will be quite sufficient to enable one to form a diagnosis between these numerous conditions above noticed, quite unconnected with Bright's disease, and those cases in which the chemical alteration of the urine coexists with the peculiar morbid state of these glands.

Having noticed those diseases in which the presence of albumen has been observed to be an *occasional* symptom, I shall next proceed to consider that affection, in which the presence

* Vide Table, page 9.

of albumen in the urine is a characteristic and constant symptom; when taken in conjunction with other equivocal signs, it is quite pathognomonic.

Of Bright's Disease of the Kidney.

Before describing the symptoms of granular disease of the kidney, I purpose giving a brief sketch of its history. To Dr Bright * the profession is deeply indebted for having first called their attention to it, and having accurately described this affection. Since that period Drs Christison and Gregory † have, as I shall show, by an extended series of observations, not only corroborated the various facts established by this originator of this kind of inquiry, but have also added many new ones connected with the history, progress, and termination of the disease, and more lately the renal disease has been ably considered by Dr Martin Solon, to whose valuable work I shall have occasion to refer.

The connection of dropsy with disease of the kidney has been noticed by some of the older authors. Thus Van Helmont, ‡ when treating of dropsies, expresses his suspicion of the cause being seated in the kidneys. Bonet mentions a case of ascites induced by an affection which had diminished the volume and size of these glands, and also describes a case of dropsy, in which, on the inspection of the body after death, the kidneys were observed to be as white as milk.

Morgagni § has given a case of anasarca, followed by diarrhœa, in which the kidneys were the only organs found diseased. “*Structura intima confusa apparuit*” are the expressions used, and will be found to convey a good idea of the usual appearances of the kidney in this complaint. He also mentions another case of a woman affected with dropsy, in which, on the inspection after death, these organs were found diseased. His words are, “*Ren uterque inequali erat superficie et maculis albis hic illicque subsidebat variegata*,”—wishing, no doubt, to describe the mottled appearance these

* Reports of Medical Cases, 1827.

† Ed. Medical and Surgical Journal, Vols. xxxii. vi. vii.

‡ Ortus Medicinæ, page 509. Amst. 1648.

§ De Sed. et Caus. Morb. Epistol. 43, art. i.

glands presented. Other authors have alluded to the *coagulability* of the urine.

Thus Cruickshank, * although incorrect in the opinion he advances with regard to the diagnosis between general dropsy and that depending on morbid viscera, is nevertheless entitled to a great share of merit for having been the first, so far as I am aware, who discovered the principle of albumen in the urine, and for having pointed out the various tests for its detection.

Fordyce also, in 1798, states that, if the kidneys be stimulated, chyle, serum, coagulable lymph, and even the red particles of the blood may be discharged by the urine. Chapotain† mentions the case of a young creole whose urine was sanguinolent, and who complained of acute pain in the lumbar region, followed by the secretion of albuminous urine. A third set of authors have gone further, and have indeed connected the *disease of the kidney* with *coagulability* of the urine. Dr Wells‡ has, in two excellent memoirs on the dropsy supervening after scarlatina, very accurately described the appearances of the urine which were found to contain albumen, the presence of which he proved in the urine of 48 out of 130 patients affected with anasarca; and in 14 out of 80 cases of hydrothorax. The urine of patients labouring under acute and chronic diseases was afterwards examined, and in 19 of the former class, and in 83 of the latter, no trace of albumen could be detected, at least so slight a proportion in some cases as not to be compared with the quantity observed in the urine of dropsics. He observes, that, in some of his cases, the *kidneys were altered in structure*, in a vague manner, it is true, says M. Andral, but expressed in terms sufficiently explicit to show that he suspected at least the cause of the dropsy. But he only gives three cases of persons who had died dropsical, whose bodies were examined after death, and whose urine had been coa-

* Appendix to Rollo on Diabetes, 1797.

† Topographie Med. de l'Île de France, 1812.

‡ Transactions of a Society for the improvement of Medical and Chirurgical Knowledge, Vol. iii. 1812.

gidable during life, and states that these organs are not always found diseased when the urine in dropsy contains much serum, and that they might be altogether unconnected with the morbid secretion.

Dr Blackall * likewise, although he has given nine cases of dropsy connected with coagulable urine, in five of which the kidneys were observed to be diseased on examination of the body after death, and in one more especially he remarks, “ that the kidneys were large and hard, particularly in respect to the distinction between the cortical and medullary part,” yet states in another place, that the connexion of an albuminous impregnation of the urine and disease of the kidney must be determined by the future experience of physicians. Dr Alison noticed the connexion of dropsy, where the urine was coagulable with hard and tuberculated kidney, in his Clinical Lectures as far back as 1823. † Dr Cramp-ton ‡ mentions, that, in three cases of dropsy in which there was an inspection of the bodies after death, the kidneys in one of them were much enlarged and soft, and although no notice is taken, as far as I am aware, of the state of the urine during life, still this author is entitled to merit in being the first who established the *inflammatory nature* of the dropsy, as he observes, that, in some of his cases, the intestines were found agglutinated together by flakes of coagulable lymph.

Such was the state of knowledge on this subject when, in 1827, Dr Bright showed that the presence of coagulable matter in the urine depended on a peculiar morbid state of the cortical or secreting tissue of the kidney.

The views of this author were, however, far from being even generally received by the profession, and it therefore remained for some persons, competent to the task, to corroborate them, which was reserved for Drs Christison and Gregory, to whose excellent papers, as they contain the most precise and accurate information on the derangement of the

* Obs. on the Nature and Cure of Dropsies, 1818.

† Gregory on Diseased Kidney, Ed. Med. and Surg. Journal, No. citato.

‡ Clinical Report on Dropsies, Trans. of Association, Vol. ii.

urinary secretion in this disease, I shall have frequently occasion to refer. The number of cases recorded by these two observers of coagulable urine were 87, and the granular deposit in the kidneys was always detected when examination after death took place. Dr Osborne † has given an account of 84 cases of coagulable urine, in which the renal disease was detected in nine after death.

M. Solon ‡ has detailed 29 well-marked cases of the renal disease.

SEMEIOGRAPHY.—The symptoms of granular disease of the kidney, as they are exceedingly numerous, may be with propriety divided with the *primary or leading*, and the *secondary or concomitant* symptoms.

a. *Primary symptoms.*—The symptoms proper to the disease are, a dull gnawing pain in the region of one or both kidneys, sometimes pain in the epigastrium extending into either hypochondrium, sickness and vomiting, occasionally pain in the hypogastric region; at the commencement of the disease there is loss of appetite, and towards the close of it chronic vomiting; but the characters by which it is best distinguished are those indicating a derangement of the urinary functions, as the preceding symptoms are not always present, and are to be considered diagnostic only when taken into conjunction with other more unequivocal signs. The lumbar pain, for instance, is sometimes altogether absent, and was remarked in only 33 out of 80 cases detailed by Dr Gregory, ‡ and is a symptom so common in many other diseases, especially among women, that little reliance can be placed on it alone.

I have had so many opportunities of observing the granular disease of the kidney in the autopsies in the Infirmary, while the patient during life had never been suspected to labour under this affection, (as the urine had not been examined during life, but was always found coagulable after death in the instances in which I tried the experiment,) that I con-

* Clinical Report on Dropsies, 1835.

† Op. citat.

‡ Op. citat.

sider the albuminous impregnation of the urine, taken in conjunction with its low density, if not quite pathognomonic, to be at least so important a symptom of the renal disease, that, whenever this is observed, the attention of the physician should be directed to an inquiry into the nature of his patient's complaints, and should lead him, if not to be certain, at least to be suspicious of the existence of granular disease of the kidney; and although, as I have previously endeavoured to point out, the urine is occasionally coagulable in other affections, besides the one in question, in which it is not accompanied, however, with a reduction of its usual density, still this fact in nowise disproves the connexion that exists between the renal lesion and that condition of the urine. The only fact capable of doing so would be, as M. Solon correctly remarks, the existence of the renal disease well characterized, without albuminous urine,—a fact which has never yet been observed.

As well might we assert that tenesmus was not a symptom of dysentery, because it is observable in other affections. In those anomalous cases coming under the province of the physician, the urine should always be examined, it is hardly necessary to mention; for in this instance we have an example of a disease so insidious in its symptoms, which are by no means well marked, that it is very often difficult to detect its presence without resorting to this measure. No apology is therefore necessary for considering at some length the morbid condition of the urine in Bright's disease.

The *physical* properties of the urine, which have before been divided into *sensible*, *mechanical*, and *chemical* characters, each suffer a derangement in granular disease of the kidney.

a. *Sensible characters*.—In respect to *colour*, the urine is very often pale; sometimes, on the other hand, it is high-coloured, being of a cherry-red tint, and contains a red sediment. In the early stage of the disease, blood is discharged along with the urine; in the middle stage it is paler than natural, and in the final stage it is also pale. Not unfrequently it is natural in colour, and sometimes it is quite colourless. With

regard to its *transparency*, it may be remarked, that it may be either clear or turbid, and contain the pale lithates. Nothing peculiar is presented by the other sensible characters of the urine, as the smell or taste.

b. *Mechanical characters*.—*α*. The *quantity* discharged during the twenty-four hours is generally less than natural, but not invariably, for it may exceed the average, especially at the commencement of the disease. The average quantity voided in health has been variously estimated, but, on the whole, 45 ounces may be considered as representing a fair general average, although it is found to range from 30 to 55 ounces.

In granular disease of the kidney, the quantity is sometimes so small, as not to exceed 12 or 16 ounces daily, and this diminution sometimes amounts to total suppression, particularly towards the close of the disease; but occasionally there is no diminution, the urine being natural in quantity; nay, sometimes there is an increase, and, in a few cases, a great increase of the daily quantity discharged in health.

The urine is voided more frequently than usual, the patient awaking two or three times during the night to pass his water, which act is occasionally attended with *dysuria*. Dr Christison is inclined to place some reliance on the frequency of micturition as a symptom, that is to say, if the patient has noticed it in early life.

β. The *density* of the urine is invariably found to be less than the natural average. The specific gravity of the urine in health has been variously estimated by almost every writer on the subject. Dr Gregory examined the urine of fifty healthy men with the view of arriving at this point, and fixes the average density at 1.02246, or 1.022, expressed in round numbers. I find it to range between 1.007 and 1.030, and, from the examination of the urine of thirty healthy men, fix the average at 1.024; although the number 1.025, as stated by Dr Alison to be the average specific gravity of healthy urine, I have generally adopted as being most convenient. Now, in the disease under consideration, the density is found on examination to be lower than the average specific gravity of the

urine in health. The average density of the urine in the renal disease Dr Gregory fixes at 1013.18, from the examination of this secretion in fifty patients labouring under this affection,—a number closely corresponding with that fixed by Dr Christison. The highest density observed by the latter author in his cases was 1.0215, and the lowest 1.0069. The highest density I have remarked is 1.025, and the lowest 1.005, and the mean density of the urine of twelve patients in whom the disease was well marked I found to be 1.013, expressed in round numbers.* The densities 1.010, 1.012, 1.016 are common; that of 1.008 not so frequent, and 1.004 may be considered very rare,—Dr Christison, I believe, having observed it so low only on one occasion.

c. *Chemical characters*.—The chemical composition of the urine also undergoes a material derangement. It is found on examination to be deficient in its proportion of urea, to have its *saline contents* diminished in quantity, and to be more or less impregnated with an extraneous principle of *albumen*, the presence of which in the urine, when coupled along with its density, is, as in diabetes, (in which another principle, foreign to the urine, makes its appearance,) quite pathognomonic.

α. *Urea*.—Healthy urine having a density of 1.029, contains as much as 55.2 per cent. of urea, with animalized acetates, in 1000 parts, as before stated. In the renal disease, however, the proportion of urea is seldom as much as half the usual proportion, and occasionally not above a fifth, according to the observations of Dr Christison, in the analysis before referred to.† Dr Charles Maitland also found a material deficiency of this principle.

β. *Saline Contents*.—The saline contents, as well as the urea, are invariably found to be defective, and usually in the same proportion, Dr Christison‡ informs us, who is of opinion that the insoluble earthy salts are always scanty, and sometimes entirely wanting.

* Vide Table at the end of this Section.

† Vide p. 15.

‡ Op. citat.

The total solid constituents of the urine, excluding the albumen or extraneous matter, are, therefore, on the whole, diminished in quantity. The total solids in healthy urine having a density of 1.029, amount to about 67 or 68 parts per 1000, but in the disease in question sometimes do not exceed two-thirds of the total amount, the deficiency of which is the cause of the low density of the urine.

γ. *Albumen*.—Lastly, the urine is found on examination to be more or less impregnated with an extraneous principle, viz. *albumen*, and the presence of which may be detected by, a. *Heat*; b. *Acids*, especially the *nitric*; c. *Alcohol*; d. *Alum*; e. *Creosote*; f. *Ferro-prussiate of Potass*; g. *Bichloride of Mercury*; h. *Tincture of Galls*.

Without entering upon the consideration of the comparative eligibility of these reagents, all of which, with the exception of creosote, I have had many opportunities of employing, I shall confine my observations to *caloric* and *nitric acid*, as they appear, I think, the best tests for the detection of the presence of albumen in the urine. On the application of a temperature of 160° to urine containing albumen in a test tube over a spirit lamp, it becomes turbid, and on elevating the temperature, a dense flocculent precipitate is observed, if the quantity be considerable; in other instances, there is no precipitate, but an opalescence merely is observed, whilst a *haziness* indicates the smallest proportion of albumen that can be detected by this test. *Nitric acid* also is a very important reagent, for heat should never be relied on alone, inasmuch as in some specimens of urine not containing this principle, a precipitate is occasioned, as I have frequently observed. This consists of the *earthy phosphates*, and if a drop or two of nitric acid be added to this deposition, it is instantly dissolved, whereas, if the precipitate should consist of *albumen*, the latter is rendered more distinct.

The only other reagent I shall notice is the *ferro-prussiate of potass*, which requires the addition of a drop or two of acetic acid, in order to act, and which then detects very minute proportions of this principle. It is, however, like the *bichloride* of mercury, too delicate: and with regard to the latter,

I have previously shown that it occasions a precipitate even in healthy urine, and that few specimens of urine will on that account resist the test. The great advantage caloric has over the others is, that it shows the extent and degree of coagulation much better, and does not add to the bulk of the liquid. When nitric acid succeeds in detecting the presence of albumen after the failure of heat, it is to be explained by the circumstance of the urine being previously *alkaline*; for in all cases of urine suspected to contain albumen, the reaction should be ascertained; for if *alkaline*, the albumen will not be discovered, but on the addition of a drop or two of acetic acid, coagulation will be observed.

The quantity of urine, also, in the renal disease passed during the twenty-four hours should always be noted; for if it be found on inquiry to be much above the healthy standard, the albumen being diffused through a greater quantity of fluid will not perhaps be detected; but if it be less on the succeeding day, coagulability will be most certainly noticed.

The albumen abounds most during the early stage of the disease. In the middle stage the urine is still coagulable; but in the final stage it disappears, or at least the coagulation is seldom very great in the advanced period. The greatest proportion of this principle detected by analysis in the urine of the cases detailed by Dr Christison was 14 parts per 1000, whilst in the urine of the cases to be mentioned in the appendix, the quantity amounted to 8.7 parts per 1000.

That the albumen found in the urine is, at least in the renal disease, whatever may be the source of its origin in other diseases, accompanied with the secretion of coagulable urine, derived principally from the serum of the blood, is evident from the circumstance, that the serum of the blood is found to be less dense than healthy serum, and to be deficient in its proper portion of this principle, and from the fact, that the urine in the earlier stages of the disease is frequently cherry-red in colour, owing to the presence of the red globules. Healthy serum, we know, has an average density of 1.030. In 7 cases of this disease Dr Gregory found the specific gravity of the serum to range between 1.0185 and 1.025, and

3 other cases being added, the mean will only be 1.021 in round numbers. In one case I found the density to be as low as 1.018. Dr Christison always found it lowest when the urine was most loaded with albumen, and thinks it probable that the discharge of albumen by the urine, as well as in the great cavities and cellular tissue throughout the body, is caused by the retention of the *urea* and salts in the system, as they are both found very defective in the urine,—a supposition which receives great weight from his having detected by analysis, as is well known, the presence of urea in the blood. This principle was also discovered in the serum of a patient affected with renal dropsy by Dr Charles Maitland. M. Marchand has succeeded in detecting the presence of urea even in the peritoneum in three cases of ascites, two of which he mentions presented Bright's disease. In the first he found 0.42, in the second 0.68, and in the third 0.50 per cent.; and he states, that two cases are given by Nysten, in which he found not only urea, but uric acid, phosphoric acid, and several other constituents of the urine, in the fluid vomited by women labouring under *ischuria renalis*. In the cases given by M. Marchand very little urine was secreted.

These facts, combined with those of Prevost and Dumas, who detected a considerable proportion in the blood of dogs from whom the kidneys had been removed, experiments which were afterwards confirmed by Vauquelin, and Ségalas, and by Mitscherlich, Tiedemann and Gmelin, satisfactorily prove that the excrementitious matter of the urine is not elaborated by the kidneys, but merely separated in that organ from the blood, in which it had previously existed. * Boerhaave long ago gave a case of *ischuria renalis*, in which he states, “*In cerebri ventriculis reperta est urina.*” The serum of the blood in the renal disease sometimes is observed to be *opalescent*,—an appearance which I have sometimes seen it present, and which is found to depend on the presence of a little oil, which may be detected by agitation with sulphuric ether.

b. *Secondary symptoms*.—Among the secondary or concomitant symptoms of Bright's disease of the kidney, *dropsy*

* Medical Gazette, June 30th 1838.

is by far the most frequent, and from being so often found to coexist with the morbid lesion of these glands, has appropriately been designated by the term of *Renal Dropsy* when this is observed to be the case. But the dropsy, though a very general accompaniment of the disease, is by no means essential. With regard to the kind of dropsy most commonly remarked to accompany the renal affection, it is anasarca; for ascites, although specified by M. Rayer to occur in France, is generally here observed to depend on disease of the liver. Dr Alison is of opinion that this symptom is remarked chiefly when affections of the chest go along with the disease. As the disease appears in this city I should certainly say that anasarca is most commonly met with. Sometimes only very slight œdema of the ankles and wrists is observed. Dr Bright * notices this symptom as having occurred in 23 out of 24 cases. Dr Gregory † noticed it in one or other of its forms in 58 out of 80 cases which he has detailed. In 22 cases treated in the Royal Infirmary of this city since August 1837, I remarked this symptom in 16. The dropsy is exceedingly difficult to remove, and generally returns sooner or later in one or other of its forms.

Diarrhœa also is a very common concomitant symptom of this disease, and is frequently very intractable, proving ultimately fatal, as in the greater number of cases treated by Dr Christison. This symptom occurred in 5 out of 24 cases detailed by Dr Bright; and was noticed with or without vomiting in 46 out of 80 cases described by Dr Gregory.

Affections of the lungs or their constituent tissues are rather frequent. *Bronchitis*, or chronic catarrh, is one of the most usual complications, and affords a very unfavourable prognosis, being generally connected with emphysema, and proves fatal by engorgement of the lungs. *Œdema pulmonum* Dr Bright observed in 31 out of 100 cases. *Pneumonia* occurred only six times in the practice of this author, but was more frequently observed by Dr Gregory. I have observed only 1 case out of 22. *Phthisis*, again, is very rarely noticed as a complication; thus, only 4 cases are mention-

* Guy's Hospital Reports, 1836.

† Edinburgh Medical and Surgical Journal, Vol. xxxvii.

ed by Dr Bright to have occurred among his cases, whilst Dr Gregory* specifies eight well marked cases.

The frequency of disease of the heart as a complication of the organic renal disease has been also remarked. Thus 73 cases presented disease of the heart, out of 100 treated by Dr Bright ; the most common affection of the heart being *hypertrophy*, especially of the left ventricle, with valvular disease ; of 52 cases of hypertrophy, 34 presented no disease of the valves ; but in 11 of these, more or less disease existed in the coats of the aorta, whether of the nature of atheromatous or steatomatous deposits, it is not mentioned. Dr Gregory also observed symptoms indicating an affection of this organ or of the lungs in 20 out of 35 cases ; and in the remaining 45 detailed, disease of the heart and great vessels occurred in 7, in the autopsy. M. Solon † observed disease of this organ in 8 out of 28 cases, and states that hypertrophy or *endocarditis* was noticed, and supposes that it is not connected with the renal disease, as the other 20 cases were exempt from this affection, but is, however, compelled to admit, that lesions of this viscus exert an influence as great over disease of the kidney as those of the liver. Of 22 cases, disease of this organ was remarked in 2, as indicated by the symptoms during life, and in 3 in the inspection after death.

Chronic disease of the liver is also common, and thus a peculiar feature presented by this disease is, that the three organs, the kidneys, liver, and even the heart itself, as has been shown, are found to be altered in structure. A tuberculated state of the liver is not uncommon as a complication of granular disease of the kidney, and phthisis also has been noticed as co-existing with a tubercular deposition in the kidneys. This organ was found more or less diseased in structure in 17 out of 41 cases, on the inspection after death by Dr Gregory.

Inflammation of the Serous Membranes.

Meningitis.—The stupor, somnolence, cephalalgia, and coma observable during the progress and towards the close of

* Edinburgh Medical and Surgical Journal, Vol. xxxvi.

† De l'Albuminurie ou Hydropisie causé par la Maladie des Reins, p. 287.

the disease, would perhaps indicate a low form of meningitis; but I believe this appearance is by no means generally observed; for cases have occurred, of which I myself saw an instance only about three weeks ago, which case will be more particularly noticed in the Appendix, in which the effusion was not appreciable in quantity, although the patient died comatose.

Sometimes, however, the brain in such cases presents uniform vascularity, or its membranes may be injected with blood, or infiltrated with serum, or the ventricles may contain, but rarely, a notable quantity of serosity, the patient dying with symptoms of *hydrocephalus*. But in other instances, the meningeal inflammation does not proceed to that stage, and consequently the effusion of which it is the result is not observable. Dr Gregory observed the injection and turgescence of the cerebral vessels only once out of 11 cases; and in the other 10, a greater or less degree of effusion within the ventricles, or at the base of the cranium was noticed.

Pericarditis and Endocarditis.—The former is a rare complication, Dr Gregory only having remarked adhesion of the pericardium to the heart only in two out of seven cases in which the heart itself was diseased.

Endocarditis has been noticed by M. Solon.

Pleuritis. Dr Bright has recorded ten cases of inflammation of this serous membrane accompanying the renal disease. M. Andral mentions only one case.

Peritonitis, too, is also observed to accompany the primary disease, and was noticed four times out of 45 cases by Dr Gregory. I have seen it once out of 22 cases.

Rheumatism has also been specified as a concomitant symptom.

Apoplexy and Coma.—There is a very great tendency to affections of the head in this disease, as indicated by the somnolency and stupor. When coma succeeds to dropsy, death usually happens in four or five days, and when it occurs with suppression of urine, this event follows in a few hours.

PATHOLOGY.—On dissection, the kidney is commonly observed to be paler than natural, and the fibrous tunic less smooth

than in the healthy state, and on making a transverse section of it, the cortical part is observed to be very thin, and the tubuli nearer to the surface than in the healthy state. At a more advanced stage of the disease, the tubular part is superseded by a deposition of *yellowish* granular matter, and the kidney appears shrivelled up, the distinction between the cortical and tubular, or medullary portions, not being so well defined as in the healthy state. The right kidney is said to be more frequently diseased than the left, and when both are involved in the disease, the right is most affected.

Dr Bright admits three forms of the disease. In the first, the kidney is soft and of a mottled yellow colour externally, the cortical part yellowish gray, and the tubular pale. In the second stage, the cortical part is converted more or less into a granulated texture as above stated, with a copious white interstitial deposit; and in the third stage, these granulations are increased, are of a yellowish, red, or purplish colour, projecting externally so as to render the surface of the kidney rough, and producing a semicartilaginous hardness of the whole gland, the tubular portions being drawn towards the surface.

Besides these, others, he thinks it probable, may be found as the cause of dropsy; particularly *ramollissement* of the kidneys without any other alteration in structure, and the obstruction of the tubular substance with a white deposition, lesions which he has stated he has observed accompanying anasarca.*

These renal lesions Drs Christison and Gregory had occasion to observe, and to these authors is due the interest which has of late been taken in the renal disease. The number of cases recorded by both observers amounted to 87, and one or other of these structural changes was always detected on the autopsy, whenever an opportunity presented itself.

M. Rayer admits *six* principal forms of the renal lesion, and proposes to designate it by the term of *néphrite albumineuse*,—an appellation more liable to objection than that of *Albuminurie*, applied to it by M. Solon.

* Bright's Medical Reports, page 67.

M. Solon* mentions five forms, which he has represented in the coloured plates appended to his work.

In the *first*, which he designates *Hypérémie rénale*, the kidneys appear sometimes gorged with blood, but the organ in this case is not increased in volume, and the red colour it presents diminishes by repeated maceration. This condition of these glands he supposes may produce some forms of hæmaturia, and that, after having continued for some length of time, the passive hyperæmia to which it gives rise may be the cause of the presence of albumen in the urine. In other instances, whether disease of the heart coexists with the renal lesion or not, the blood is determined in greater quantity towards the kidneys, and, penetrating their tissue, tends to unite with it, and produce active hyperæmia. The kidney thus reddened, hypertrophous, resisting, weighing from seven to eight ounces, and sometimes double the natural size, presents hypertrophy of its cortical, but not of its tubular portion; the blood unites with these structures, and cannot be removed by repeated ablutions; the tissue of the organ is more friable; the granules entering into the composition of the cortical substance appear commonly more distinct and of greater size, and stellated red and blackish spots resembling ecchymoses are observed disseminated over its surface and throughout its interior.

In the *second* variety, the tissue of the kidney still presents hypertrophy, and is covered with yellowish patches, traversed occasionally by whitish striæ, resembling the furrows which separate the different lobes composing this gland in the foetal condition.

In the *third* degree, hypertrophy of the cortical substance is still noticed. The external surface is commonly smooth and polished, or tuberculated, of a pale yellow-colour, and internally of the same tint; the cortical substance penetrates into the tubular portion, which is observed to present the same yellowish deposition as the former; the kidney is soft and friable, but possesses a certain degree of resistance, and its parenchyma yields on expression a whey-like fluid in some instances, but most commonly it is dry, and at first sight appears to resemble the fatty degeneration observa-

* Op. antea citat. p. 194, et seq.

ble in the liver, with which structure it might be confounded. Neither the vessels, nerves, nor pelvis are affected.

In the *fourth* species, the granulations described by Dr Bright are observed, which M. Solon considers to be a rare form of the disease.

Among the *fifth* variety are classed all the adventitious products and degenerations presented by the kidneys in Bright's disease, of which *atrophy* is the most rare, according to this author; but this has been often noticed by Drs Bright, Alison, Christison, and Gregory.

The next lesion in point of rarity was *induration*, but of this Dr Gregory has given many examples. *Cysts* and *tubercles* were also noticed. M. Solon, although he has admitted five forms of the disease, is yet inclined to unite his fourth and fifth varieties, but supposes that the state of hyperæmia, his first form, precedes all the others.

DIAGNOSIS.—If we deny the fact of an albuminous impregnation occurring in the urine in any other disease but the one in question, then is the diagnosis exceedingly easy, but if, on the other hand, we place reliance on the observations of M. Solon, and are inclined to admit that this fluid is coagulable in other affections, more especially at the crisis of acute diseases, then it becomes a matter of much importance to distinguish these two cases. Enough has already been said in a former part of the essay on this subject, to show that, even if this fact be allowed, this fluid will be found to present different characters in these two similar conditions. It has previously been mentioned that this condition of the urine has been observed in fevers by Berzelius,* by Sir Charles Scudamore,† and Mr Howship in gout, by M. Solon at the crisis of acute diseases, and in diabetes by most writers on the subject. There are those, however, who are of opinion that in all these instances the renal disease may have existed; and with regard to rheumatism, it has been shown that this disease is observed to coexist with the renal lesion; but whether this be the case or not, certain it is, that the urine has been found to be coagu-

* Berzelius, op. citat.

† A Treatise on the Nature and Cure of Gout and Rheumatism, p. 293, 1819.

lable in the diseases above-mentioned. In respect to this condition of the urine having been observed in fevers, I may mention that it is quite possible, nay, I may say, next to certain, that Bright's disease may co-exist with *synochus*, as well as with *any other* disease, several instances of which have been observed at the inspections in the Royal Infirmary.

In a case of *colica pictonum*, under the charge of Dr Alison, the kidneys, on the inspection which took place on August 11th 1837, presented Bright's disease very characteristically; and the urine, although not examined during life, was found to be coagulable after death. In this instance, therefore, had the urine been found albuminous during life, the fact might have been brought forward by those who believe that this condition of the urine occurs in other diseases, as supporting their opinion, if an inspection had not taken place. Hence it is probable, that as the renal disease has been found to co-exist with many diseases of very different character, as has been previously pointed out, that even in fevers, at the crisis of acute diseases, and in gout, in which affections an albuminous impregnation of this fluid has been noticed, the disease of the kidney was actually present, so that, on the whole, I think, that coagulability of the urine is a certain diagnostic of Bright's disease.

But even allowing that an albuminous impregnation of the urine takes place occasionally from slight derangements of digestion, yet, I think, enough has already been said in a former part of this essay to show, that the diagnosis between these apparently allied cases is easy and satisfactory.

In conclusion, the *crisis per urinam*, in which this fluid is said to become coagulable upon the resolution of acute diseases, a doctrine first started by M. Solon, does not, in my opinion, go to disprove the existence of Bright's disease in these cases. The originator of this theory has not given a sufficient number of dissections to show its absence, when the urine during life had been found to be coagulable; and although when this was observed, and an examination took place, these glands were found healthy, still even this objection to the argument is at once met, when we recollect the circumstance, that the

urine may be loaded with albumen, and yet no disease of the kidneys be observable after death, in the *incipient* stage of the disease, as established by the observations of Dr Christison.

PROGNOSIS.—The prognosis will depend upon three circumstances. *1st*, On the chance of recovery from the primary disease; *2dly*, From the secondary complaints; and, *3dly*, On the chance of its recurring.

1st, With regard to the chance of recovery from the primary disease, it may be remarked, that, when recent, it has been entirely removed as far as that is possible; but it often runs through its progress, and remains latent for years without giving signs of its presence. In the dropsy supervening upon scarlatina, which depends on disease of the kidney, as treatment is almost always had recourse to early, there cannot be any doubt of a complete cure having been effected, as observed by Drs Alison and Christison, and more recently by my friend Dr Stark.* Of fifteen cases treated by the last author, in which dropsical *sequelæ* occurred, only one died. In the advanced stage, however, when the cortical and tubular parts of the kidney are affected, it is needless to say that a cure is impossible; but even in the advanced stage the patient may keep comparatively in good health, if he does not expose himself to cold or to intemperance, and thus we can bring the disease to an indolent state; but the case is different if there are any secondary affections.

2dly, In respect to the chance of recovery from the secondary affections sometimes observed to co-exist with the primary disease, we may remark, that chronic vomiting, which is an accidental symptom, is very intractable, and proves exceedingly obstinate when not connected with dyspepsia, and the patient may, indeed, fall a victim to this symptom alone, of which two instances are noticed by Dr Christison.

The dropsy is very much under the physician's control, and may be either relieved or entirely removed. In all cases the disappearance of dropsy is a favourable sign, followed by

* Stark on Scarlatina, Ed. Med. and Surg. Journ., No. 129.

a long interval of good health, if the organic derangement of the kidneys is not far advanced, but its removal does not prevent the occurrence of coma in the advanced stage.

Diarrhœa and dysentery may be considered as offering a very unfavourable prognosis.

Inflammation of the serous membranes, of which many cases are recorded by Dr Bright, but which is a rare complication in the practice of the physicians of the Royal Infirmary, it is unnecessary to state, affords an unfavourable prognosis.

Disease of the heart or of the liver is untractable.

Catarrhal affections may be removed, and the spasmodic dyspnœa relieved by antispasmodics.

The developement of fever, cephalalgia, somnolence, apoplexy, and coma, announce that the fatal termination is near at hand.

3dly, In regard to the chance of its recurring, this will depend in a great measure upon the state of the urine. When the albumen abounds the case may be considered as recent. The disappearance of the albumen may be regarded as a favourable sign, but in the advanced stage the proportion of albumen is very small. The prognosis is unfavourable when the urine is colourless, scanty, of very low density, for instance 1.008, 1.006, and contains a large quantity of albumen.

It becomes more favourable when the urine froths less, regains its normal colour, and the albuminous precipitate presents a rose tint, as the latter appearance indicates the return of the uric acid. An increasing proportion of urea, greater putrescibility of the urine, and a more abundant precipitate by oxalic acid, announcing the reappearance of some of the normal salts of this fluid, augur a favourable termination.

ETIOLOGY.—This disease is usually attributed to exposure to cold, and may be induced by the habitual use of spirituous liquors in persons in whom there exists a predisposition to it, although it undoubtedly occurs in individuals of temperate habits. It is most frequently observed about the period of the middle age, seldom occurring before puberty, but sometimes it attacks young children, more especially after scarla-

tina ; but even in them it may exist without a previous attack of this disease,—an example of which occurred a few weeks ago in the Royal Infirmary, in the person of a boy twelve years of age, of the name of Lamb. Dr Christison mentions only one case in which the person affected was below puberty, which occurred in a boy eight years of age.

I have also seen a well-marked case of the disease, on inspection, in a boy at the same age, a drawing of whose kidney will appear in the Appendix.

TREATMENT.—In the treatment, our curative measures must be directed, *first*, to the removal of the primary disease ; *secondly*, to the accidental affections ; and, *thirdly*, we must endeavour to prevent its recurrence.

In the acute form of the disease depleting remedies must be employed, such as free blood-letting and brisk purging, conjoined with low diet, and even in chronic cases this plan is often found advantageous. In the chronic form, however, local bleeding is more generally useful, combined with purgatives and diuretics, if dropsy be present, the former of which class Dr Traill considers preferable under these circumstances. In cases where a deposition of lymph has taken place in the cortical part of the kidney, Dr Alison thinks he has seen mercury useful. It requires, however, to be given very cautiously, if it, indeed, be prescribed at all, so as not to produce any constitutional action on the system ; combined, however, in small doses with digitalis, the diuretic power of the latter is much increased.

In the treatment of the secondary affections the dropsy first claims attention, as it is the most common, and when acute, the same treatment should be adopted as in the early stage of the primary disease. Free blood-letting is quite essential, since the dropsy is inflammatory, by the employment of which local pain is diminished, oedema is lessened, and the urine, moreover, is rendered less albuminous. If lumbar pain be present, it is by this means removed, and the irritation of the kidneys, on which the secretion of albumen depends, is materially lessened. As regards the quantity of blood drawn, we should

be guided by the state of the pulse; if reaction occurs, local blood-letting should be employed. When the dropsy is acute, diuretics act more slowly; when very urgent, we must have recourse to diuretics, and of these digitalis, supertartrate of potash, carbonate of potash, and gin-punch may be employed.

Digitalis is not a good diuretic when given alone, but, if combined with mercury, it proves very beneficial. If, for instance, it be prescribed alternately with a mercurial pill, the medicine will act in three, five, or seven days; but if its action does not develop itself in seven days, it will not act at all, and another diuretic must be prescribed.

Cream of tartar is more useful than digitalis, and may be given when it ceases to act, or may be combined with it; when given alone, from two to three drachms may be prescribed in the form of powder, three times a day. It will act in two, three, or four days; but if it does not then act, the dose may be increased to three drachms thrice daily; and even then, if diuresis be not induced, it will act as a hydragogue cathartic, producing copious watery discharges, so that its cathartic action is very beneficial. Carbonate of potash given in doses of half a drachm is also a good diuretic. Gin-punch has been found useful in the advanced stage of the disease. That popular diuretic, too, the *Spartium Scoparia*, is not to be despised. I have seen it employed by Dr Traill in two, if not in three, cases, with success; and the great advantage it possesses over others is, that its employment is never attended by any of those unpleasant symptoms produced so often by the stimulating diuretics. The *Spiritus Ætheris Nitrosi* may also be given, and continued for one or two days.

Tobacco, a diuretic introduced by Dr Fowler, and employed by him in cases of dropsy with success, has been tried by Dr Christison in the form of tincture; but I believe its use has not been attended with any material advantage.

During the action of these diuretics, the urine becomes more healthy, its coagulability diminishes, and the œdema abates.

This class of medicines does not increase the albumen, as stated by Dr Osborne; on the contrary, as above stated, the

urine is rendered more natural by their employment. Mercury if employed should be combined with digitalis, so as to increase the diuretic action of the latter, for, as mercurial action is very easily induced in this disease, and assumes a very malignant action, according to Dr Bright, it should be only employed according to the manner just mentioned.

When diuretics do not succeed, cathartics may be employed, and of these, croton oil, gamboge, or elaterium may be used, all which drastic cathartics produce copious watery evacuations; but the mild ones, cream of tartar, for instance, answer all purposes fully as well, for its action is developed without either tormina or exhaustion.

Besides diuretics and cathartics, friction has been employed to remove the dropsy; but this does not remove the cause, and is not therefore of much use, for the dropsy will return after it is discontinued.

Diarrhœa, if taken in time, and if it be merely ordinary diarrhœa, may be arrested by alternating a gentle laxative with an opiate; but when of long standing, astringents, as the acetate of lead, combined with opium, must be employed, in the proportion of three grains of the former, to a half or a quarter of a grain of opium, or solid opium may be prescribed.

Chronic vomiting is best checked by creosote given in solution with distilled vinegar and water, in the proportion of four drops to a five-ounce mixture, a drachm of which may be given three times a day. Hydrocyanic acid has also been employed with the same intention, a solution of which may be employed in the proportion of twelve drops to four ounces of water, a drachm of which may be taken when nausea is urgent. When this symptom is connected with dyspepsia, the sulphate of quinine has been found advantageous, or the infusion of quassia combined with the bicarbonate of potass.

If there be stupor, cephalalgia, or somnolency, we must be on our guard, and employ cathartics, apply blisters to the head; but blood-letting cannot be used in the advanced stage; but if these symptoms occur in the incipient stage it is more called for.

In conclusion, it may be remarked, that diuretics alternated with cathartics appear on the whole to answer best for the removal of the dropsy, and a combination of gamboge with the supertartrate of potass, in the proportion of four grains of the former to a drachm of this salt in the form of powder, is a favourite prescription of some of the clinical physicians, and may be considered as a very efficacious remedy. M. Solon places much confidence in the hydragogue effect of cathartics, and prescribes a combination of gamboge, aloes, hellebore and jalap; but the milder cathartics answer fully as well.

The only other plan of treatment we have to notice is that recommended and practised by Dr Osborne, viz. the employment of diaphoretics. This author adduces many satisfactory reasons to prove, that the most common cause of the disease of the kidney is suppression of the healthy secretion of the skin (*Anidrosis*,) produced by cold. In twenty-two out of thirty-six cases, the disease could be referred to suppressed perspiration. Whenever general perspiration came on spontaneously, or was induced by medicine, the cases always terminated favourably. He further endeavours to show the close analogy between the organic renal disease and diabetes. Thus both are frequently caused by cold, so applied as to check perspiration; the skin is dry in both, with a disordered secretion of urine, and in both the restoration of perspiration greatly contributes to the cure. But in diabetes, the quantity of urine is greatly increased, for as the skin no longer perspires, and as the bowels are either constipated or not relaxed, the only exit for the superfluous secretion is by the kidneys.

But in the organic renal disease, neither the skin nor kidneys are outlets for the superfluous matter, for the skin no longer acts, and the urine, which is often scanty, is always deficient in solid matters, (salts and urea,) and the dropsical effusion into the cellular tissue or serous cavities is the result. When the mucous surfaces are irritated or inflamed, and cause catarrh or diarrhoea, and secrete freely, the superfluous fluid which, in the normal state, would have passed by

the skin and kidneys, is, in some degree, evacuated from the system. Among the diaphoretics employed, hip-baths, or general baths, were prescribed, and a purgative was generally given previously to their employment. This plan has been found to succeed, I believe, only in the incipient stage of the disease.

Table showing the specific gravity and degree of coagulability of the urine in twelve well-marked cases of the renal disease.

No.	Name.	Age.	Densities.		Trials.	Coagulability.	
			Extremes.	Mean.		Caloric.	Nitric acid.
1	Taylor,	29	1.023 ; 1.010 ; 1.016		20	Strongly.	Strongly.
2	McKenzie,	45	1.014 ; 1.005 ; 1.010		20	Ditto.	Ditto.
3	Cunning,	62	1.025 ; 1.015 ; 1.019		6	Slightly.	Ditto.
4	McNab,	35	1.019 ; 1.012 ; 1.017		6	Very strongly.	Ditto.
5	Pearson,	65	1.019 ; 1.014 ; 1.017		6	Strongly.	Ditto.
6	Connor,	69	1.020 ; 1.015 ; 1.016		6	Slightly.	Slightly.
7	Hutcheson,	23	1.012 ; 1.005 ; 1.0076		9	Strongly.	Strongly.
8	Green,	48	1.022 ; 1.008 ; 1.0163		9	Very strongly.	Very strong.
9	Wright,	55	1.025 ; 1.015 ; 1.0208		5	Very coagulab.	Very coagul.
10	Cuthbertson	55	1.006 ; 1.006 ; 1.006		2	Very strongly.	Very strong.
11	McCulloch,	41	1.010 ; 1.007 ; 1.0085		2	Coagulable.	Coagulable.
12	Lamb,	12	1.010 ; 1.010 ; 1.010		2	Slightly.	Strongly.
				121642			
			General aver. 1.0136				

Note.—The first 6 cases occurred in the Royal Infirmary whilst I was acting as clinical clerk. In the remaining 6, the density of the urine was carefully noted by my friend, Mr E. R. Roberts, who filled the same situation during the summer. To these 8 other cases might be added; but this table will serve the purpose.

b. Principles found in the Natural Secretions.

4. Bile.

That the urine in severe cases of icterus contains bile is a fact which has been known ever since the time of Cruickshank. Bilious urine has generally a kind of greenish tint, and will stain linen, calico, &c. yellow. If the urine, however, be highly charged, the colour will be deep-brown. Its

taste is intensely bitter. On being shaken it becomes frothy. These are the physical characters presented by urine, containing in solution the colouring matter of the bile; but there are certain chemical tests which, on being added to urine of this description, strike with it a green tint, for which purpose the nitric or muriatic acid is successfully employed. Either of these acids, when added to bilious urine, occasion in most cases, after some time, a deposit of a green colour, if this secretion be highly charged with this principle. In other instances, where the quantity is but small, evidence of its presence will not be ascertained, till after concentration or filtration of the urine, when, on the addition of either of these tests to the matter left on the filter, a green coloration will be perceptible. In cases where the proportion of biliary colouring matter is very great, and a green deposit is obtained by the action of the acid, this, when collected and washed, will be dissolved by nitric acid, with a considerable play of colours,—the green passing into various shades of blue, violet, and pink; ultimately, however, especially if the acid be in considerable quantity, or heat be applied, into yellow. Bilious urine, however, contains in some cases that peculiar modification of colouring matter which is not precipitated of a green tint, but of a brown colour, by acids. It sometimes happens that bilious urine yields a deposit, which, when collected upon a filter, appears in the form of orange-yellow flocculi, consisting chiefly of the colouring matter of the bile. By exposure to the air, these flocculi become green, and when dissolved, which they easily are by a solution of caustic potass, give the same reaction with nitric acid as described above. In these cases, however, where bilious urine lets fall rather an abundant and somewhat ropy deposit, of a green or yellowish-green colour, it will, when carefully examined, be found to consist chiefly of mucus, tinged with biliary colouring matter, in the same manner as mucus from the stomach is not unfrequently found of a green colour, from admixture with bile.

The urine of a woman affected with jaundice, examined at the request of Dr Traill, I found to be of a high brandy-

colour, very clear, and presenting an oily appearance superficially, reaction slightly acid, density 1.008, not coagulable either by heat or nitric acid, and only a slight milkiness occasioned by the bichloride of mercury. In testing for the presence of biliary colouring matter, with muriatic acid, no change was observable, till after filtration, when a yellow substance was left, to which, on adding a drop of the acid, a green coloration was produced, which subsequently passed into various shades of blue, violet, and pink. The only morbid condition of the urine with which bilious urine might perhaps be confounded is bloody urine, and from which it becomes a matter of great importance to distinguish it. Urine containing *Hæmotosine*, or the colouring matter of the blood, we have shewn elsewhere to undergo a change more or less marked by the application of heat, in consequence of an albuminous impregnation, or, in other words, to possess the property of coagulability. Now, as albumen does not enter into the composition of healthy bile, this effect is not observed to take place on the application of heat; and even should the bile passing through the urinary passages become mixed with albuminous matter, no coagulation even in that case would ensue upon the application of heat, unless the proportion of the latter were very considerable in quantity compared with the proportion of biliary matter; for bile, according to the experiments of Powell, possesses the curious property of *preventing* the coagulation of small quantities of albuminous matter, even after the latter has undergone that peculiar change which is produced by coagulation. Lastly, in connection with the present subject, it may be observed, that the urine sometimes presents so deep a colour as to lead to the suspicion of the colouring matter of blood or bile; but in these cases a positive deficiency of urea and uric acid has been remarked by Brett,—the only organic principle in excess appearing to be the colouring matter.

5. *Caseum*.

This principle is stated by Berzelius to occur in the urine in disease; and when this is the case, it deposits cream, and

coagulates on boiling.* The coagulum was found to possess the properties of caseum, and was converted by ether into a fatty matter. It was remarked in the urine of women as well as in that of men, and appeared to be produced by some unknown internal causes, and was sometimes indeed noticed without any derangement of health. A peculiarity in the urine of *pregnant* women has long been a matter of popular belief ; and in the work of Savonarola, published in 1486, a minute detail of the changes which that secretion undergoes in the different periods of pregnancy, up to about the sixth month, is given. According to this writer, “ the urine is clear, and of a pale citrine colour, with a cloud on its surface ; and about the middle of the fluid, a deposit like carded wool is observed ; but as pregnancy advances towards its close, the urine becomes redder and turbid when stirred,—a fact which has more lately been verified by Fodéré ; and more recently M. Naache has brought this subject before the profession. He says, by allowing the urine of pregnant women, or of nurses, to stand for some time, in thirty or forty hours, a deposit takes place of white, flaky, pulverulent, gruinous matter, being *the caseum or peculiar principle of milk* formed in the breasts *during gestation*. The precipitation is more readily procured by adding a few drops of alcohol to the solution ; and to this observation he subjoins a very strong case, in which he ventured to affirm the existence of pregnancy in a woman who was subsequently examined, both *per vaginam* and with the stethoscope, by several medical men, and pronounced not to be with child ; but her delivery shortly afterwards evinced the accuracy of his previous diagnosis. The editor of the *Lancette Francaise* found this test perfectly correct in one case. Dr Montgomery,† to whose valuable work I am indebted for the preceding observations, has observed the peculiar deposit in every instance of pregnancy where the fluid was clear ; but when deep or turbid no opinion could be formed whether it existed or not ; and he describes it as presenting the appearance as if a little milk had been

* Op. citat, Vol. vii. p. 403.

† On the Signs and Symptoms of Pregnancy, 1837.

thrown into the urine ; and having sunk through it, had partly reached the bottom, while a part remained suspended, and floating through the lower part of the fluid, in the form of a whitish semitransparent, filmy cloud. In some cases in which pregnancy was suspected, but did not exist, no such deposit was noticed. Although no doubt a great many accidental causes are capable of altering the condition of the urine, which should put us on our guard in attaching credit to a symptom so equivocal, still, if the urine should be found, when in a favourable state for observation, constantly to exhibit this peculiar deposit during pregnancy, to which Dr Montgomery states he has not met with or heard of a single exception, its absence would obviously be of considerable value in enabling us to decide against the existence of pregnancy. Plausible as these observations may appear, and of their truth I have not the least doubt myself, still it becomes a matter of some difficulty to detect it *chemically*, and that is the only method of discovering the presence of any substance, to ascertain whether this deposit be caseum or not ; for caseum, we all know, to be so closely allied to albumen in all its properties, that the point in question is not very easily ascertained.

In the few cases of pregnancy I have seen, the sediment under consideration has been always remarked. In three cases it was noticed, but in only one of these was the urine examined. In all the three, however, a thick whitish sediment was observed, which coagulated on the application of heat. That it did not consist of albumen, unless we suppose that that principle was in a very considerable proportion, was evident by its not being retained in solution. In the only case in which the deposit was examined, the urine was of a pale citrine colour ; acid ; s. g. 1020 ; turbid, with a copious *whitish sediment*. The urine itself was found coagulable by heat, and that the precipitate did not consist of the earthly phosphates is also obvious from the effect produced on the deposit both by heat and nitric acid, on the application of both of which distinct coagulation was produced.

III. MORBID CONDITIONS OF THE URINE OCCASIONED BY THE ADDITION OF NEW PRINCIPLES FOREIGN TO THE BLOOD.

a. *Principles generated within the system.*

1. *Sugar. Diabetes.*

The diabetes, hydrops matellæ, profluvium urinæ, dipsacon, morbus sitibundus, or diarrhœa ad urinas, (for these are the terms by which it has been designated in different ages,) is a disease which has at all times attracted much attention from physicians. Although Hippocrates does not mention the disease expressly by name, it is, however, not improbable, that, from some expressions in his Aphorisms, Prognostics, and Prorrhethics, that it was known to him. Thus in his eighty-second and last aphorism, when speaking of “excretions *by the bladder*, by the bowels, by the fleshy parts, or in whatever way the body deviates from its healthy condition,” he states, “that these derangements should be inquired into: for if such departure be but trifling, the disease will be also trifling; if great, the disease will be considerable; *and if very much, that it then becomes mortal.*”^{*} Whether Hippocrates understood anything respecting diabetes or not, the disease has been described by Galen. The best account, however, given by the ancients is that of Aretæus, who has entered into a long description of the disease, and supposed its cause to proceed from moisture and cold, as in dropsy, and states, “that it is a very miraculous disease not very common among men; that the thirst is insatiable, and the frequent draught of liquid bears no proportion to the excessive discharge of urine.”[†]

Among modern authors, Willis appears to have been the first who discovered the saccharine condition of the urine in 1627, and nearly about the same time Sydenham notices this

^{*} ‘Οκοῖτα καὶ ἐν τοῖσι κατὰ τὴν κύστιν καὶ τοῖσι κατὰ τὴν κοιλίαν ὑποχωρήμασι, καὶ ἐν τοῖσι κατὰ τὰς σάρκας καὶ ἢν πᾶ ἄλλη τῆς φύσεως ἐκβαίνει τὸ σῶμα ἢν ὀλίγον ὀλίγη νοῦσος γίνεται ἢνδε πολὺ πολλὴ θανάσιμον τὸ τοῦτον. Hippocratis, Op. omnia. Auctore Foesio. fol. Genevæ. 1657, Tom. xxi. Sect. vii. Aphorism 82, p. 1261.

[†] Aretæus de Causis, Signis, et Curatione Morborum, fol. Lugd. 1735.

disease. The few but judicious remarks of Dr Cullen and Dr Heberden on diabetes were succeeded by the investigations of Baillie and Home ; and the celebrated treatise of Dr Rollo, which appeared in 1797, was followed by those of Girdlestone, * Watt, † and Latham, ‡ and the memoirs of Henry, § Bostock, || Ferriar, ¶ Satterly, ** Venables, †† Bardsley, ‡‡ Kane, §§ and many others.

A great deal of confusion has arisen from the vague use of the term Diabetes,—the true signification of which few authors appear to have kept steadily in view. It has been applied to a variety of diseases differing altogether in their nature, and agreeing only in the circumstance of being accompanied with diuresis, or a large flow of urine.

Diabetes ought to be applied only to that disease, the characteristic symptom of which is the saccharine condition of the urine. *Diabetes insipidus* is an expression which should be expunged from nosology, because the diseases which have been confounded under this appellation are very different in character, and characterized by those morbid conditions of the urine caused by an excess of urea, being, as I have formerly shown, merely cases of diuresis.

SEMEIOGRAPHY.—In diabetes “ the appetite is usually better than in health ; there is uneasiness in the stomach after meals ; the thirst is urgent ; the mouth dry and parched ; tongue white and foul, sometimes unnaturally clean and red ; tough disagreeable mucus in the throat ; depraved taste ; skin

* A Case of Diabetes, with an Historical Sketch of that disease, 1799.

† Cases of Diabetes, Consumption, &c. 1808.

‡ Facts and Opinions concerning Diabetes, 1811.

§ Experiments on the Urine discharged in Diabetes mellitus. ext. in Medico-Chirurg. Trans. of London, Vol. ii. 1811.

|| Observations on Diabetes insipidus, ext. in op. eodem. Vol. iii. 1812.

¶ Medical Histories and Reflections, Vol. iv. 1813.

** Cases of Diabetes, ext. in Med. Trans. Coll. Med. Lond. Vol. v. 1815.

†† Practical Treatise on Diabetes, 1825.

‡‡ Cases of Diabetes, ext. in Hospital Facts and Observations, 1830.

§§ On the Composition of the Urine and Blood in Diabetes mellitus, ext. in Dublin Journal of Medical and Chemical Science, Vol. i. 1832.

dry and unperspirable ; considerable emaciation ; weariness and aversion to exercise ; loss of strength ; pain and weakness in the region of the kidneys ; irregular generally costive state of the bowels ; some degree of inflammation and uneasiness about the external orifice of the urethra ; loss of virility ; chilly state of the body ; cold feet ; a tendency to œdema ; heat and uneasiness in the stomach and bowels ; acid eructations ; flatulence ; eyes muddy and painful ; indistinct vision ; vertigo ; headach ; dyspnœa on the least exertion ; gums spongy and ulcerated ; weight about the præcordia ; a tendency to sigh ; listlessness ; mind weak and peevish ; spirits greatly exhausted ;”* pulse variable, but generally marking debility.

Such is the dreadful catalogue of evils which more or less harass the unfortunate victims of this formidable disease.

“ As it proceeds the debility increases, and some pulmonic symptoms, accompanied by hectic fever, generally make their appearance, which sooner or later prove fatal. Occasionally it terminates in incurable dropsy, and sometimes the patient is cut off suddenly.”

It is the secondary or intercurrent affections which generally cut off the patient, for persons affected with the disease have been known to recover so far as to enjoy comparatively good health. Of these secondary affections, tubercles in the pulmonic tissue have been noticed to be the most common.

The characters by which the disease is, however, best distinguished are, as in the renal disease, those indicating a derangement of the urinary secretion, which I shall consider at some length.

In diabetes the sensible, mechanical, and chemical characters of the urine suffer a material derangement.

a. *Sensible characters*.—The urine is in colour pale straw, or yellowish green, with an odour similar to that of honey, devoid of any urinous smell, and of a saccharine taste. It is, however, important to observe, that if the salts be abundant, the last property will not be recognized.

b. *Mechanical characters*.—*a*. It is almost unnecessary to ob-

* Watt on Diabetes, p. 159, et seq. 1808. Prout, op. citat. p. 64.

serve, that the *quantity* discharged during the twenty-four hours is always greater than natural, and generally exceeds the quantity of liquids taken, however abundant. This immoderate discharge of urine is the principal symptom of the disease, and has been observed by Venables to be a frequent cause of *tabes* in children. Fonseca mentions a case in which the patient discharged 200 pints in the twenty-four hours; but it is scarcely necessary to say, that the measure he used could not have corresponded with the English pint. The average quantity of urine discharged in the twenty-four hours by diabetic patients may be estimated at twenty pints. As the quantity voided generally if not always exceeds that of the liquid ingesta, it has hence been supposed by some authors, that, as the cuticular secretion is often almost entirely arrested in diabetes, the unusual discharge of urine might take its rise from this circumstance; but, since the average amount of perspired fluid during twenty-four hours, from the experiments of physiologists, is about thirty ounces, this explanation cannot account for the very great excess of the egesta over the ingesta, even allowing, for the sake of argument, that the fluids belonging to this obstructed secretion are all carried to the kidneys of diabetic patients.

Neither can the unequal proportion the egesta bear to the ingesta be explained upon the principle of bodily decomposition, since Dr Bardsley * observed this circumstance when the patient increased in weight. Some authors, I am aware, Dr Dill† among others, are of opinion, that the fact may be accounted for on the principle of absorption by the skin; but Dr Bardsley's observations would appear to militate against this supposition.

The quantity of urine discharged in diabetes, independent of the other egesta, has been reported to be more than double the *whole* ingesta, although, according to Mr Watt, ‡ in the

* Hospital Facts and Observations, p. 171, et seq.

† On Cutaneous Absorption. Op. antea citat, p. 352.

‡ Cases of Diabetes and Consumption, p. 158.

best authenticated cases, this enormous difference between the quantity of ingesta and urine has not been observed.

The following case, therefore, possesses peculiar interest, inasmuch as this excess of the urine, independent of all the other egesta, over the total ingesta, was undoubtedly remarked; and although the following table is not so accurate as could be wished, and perhaps only affords a near approximation to the truth, because the weight of the patient was not ascertained during the period mentioned, still it serves to illustrate the point in question.

The case occurred in the person of Catharine Hannay, aged 19, who was this year admitted as a patient into the Royal Infirmary, on July 2d. On the 3d and 4th, the quantity discharged amounted to 528 and 624 ounces respectively in the twenty-four hours; but the liquid ingesta were not measured till the 7th. In the table the solid ingesta have been added.

Date.		Total ingesta in ounces.					Urine in ounces.	
		Liquids.		Solids.				
July	7,	-	70	+	38	=	108	256
	8,	.	52	+	38	=	90	288
	9,	-	54	+	38	=	92	288
	10,	-	38	+	38	=	76	168
	11,	-	30	+	38	=	68	168
	12,	-	30	+	38	=	68	168
	13,	-	30	+	38	=	68	144
	15,	-	32	+	38	=	70	144
	16,	-	32	+	38	=	70	192
	17,	-	32	+	38	=	70	192
	18,	.	32	+	38	=	70	192
			432	+	418	=	820	2200—820=1380

From the preceding table, therefore, it appears, that in eleven days there remains 1380 ounces, or 115 pounds, unaccounted for, or the quantity of urine, independent of *all the other egesta*, exceeded the total ingesta by 125 ounces, 3 drachms, 1 scruple, or by nearly $10\frac{1}{2}$ pounds daily.

β. Density.—The hydrostatic characters of diabetic urine deserve attention. The specific gravity of this fluid is found

on examination to be higher than that of healthy urine, although not invariably, since Dr Henry found it sometimes as low as 1.028, and states that it never exceeds 1.040, which numbers he considers as the two extremes. Of nine cases of diabetes, eight of which have been admitted into the Royal Infirmary during the last seven months, and in which the specific gravity of the urine was determined, I found it to range between 1.031 and 1.055, and the average density will be seen from the following table :

No.	Name.	Mean specific gravity of Trials.	
1	Reuben Stevenson, -	1.038	10
2	Thomas Smith, - -	1.034	10
3	Benjamin Chisholm, -	1.032	1
4	Robert Fraser, - -	1.040	12
5	Thomas Graham, - -	1.054	2
6	Peter Dudgeon, - - -	1.038	4
7	Catharine Hannay, - -	1.036	1
8	Mrs Boog, -	1.040	1
9	J. B. -	1.031	1
General average,		1.038	

The urine being increased in density contains, therefore, a larger proportion of solid matter than healthy urine. Healthy urine of density 1.029 contains 68 parts of solid matter in 1000 parts. Diabetic urine, however, contains a much greater proportion of solid constituents. In two of the cases just noticed, when the density of the urine was 1.038 and 1.034 respectively, 1000 grains of the urine gave in

1. FRASER.	2. SMITH.
Sp. Grav. 1038.	Sp. Grav. 1.034.
Quantity, 360 ounces.	Quantity, 120 ounces.
Solid matter, 86	Solid matter 80
Water, 914	Water, 920

In the case of Hannay, Dr Christison found the urine to contain as much as 9.3 per cent. of solids, or 93 in 1000 parts, when the density was 1.036. In that of Fraser, Dr Charles Maitland obtained in 1000 grains,

Solid matter, 101.8
Water, 898.2

When the density was 1.0407, and the quantity discharged *per diem* 432 ounces, the residuum had a sweet and nauseous

taste, not like honey, in colour yellowish, and after being washed with cold alcohol, a portion dissolved which refused to crystallize with nitric acid at 32° , but gave some bubbles of gas indicating urea. No albumen could be detected on boiling. In the case of Dudgeon, Dr Christison found the urine to contain, when it had a density of 1.036, as much as 12 per cent. of solids. In Captain Meredith's case, described by Dr Rollo, Mr Cruickshank* found the solid matter to constitute more than one-twelfth of the urine.

Dr Henry has constructed an accurate table, in which the quantity of solid matter is inferred from the density of the urine.

Specific gravity compared with 1000 parts of water at 60°.		Quantity of solid extract in a wine pint.		Quantity of solid extract in a wine pint. in			
		grains.		oz.	dr.	scr.	gr.
1.020	-	382.4	-	0	6	1	2
1.021	-	401.6	-	0	6	2	1
1.022	-	420.8	-	0	7	0	0
1.023	-	440.0	-	0	7	1	0
1.024	-	459.2	-	0	7	1	19
1.025	-	478.4	-	0	7	2	18
1.026	-	497.6	-	1	0	0	17
1.027	-	516.8	-	1	0	1	16
1.028	-	536.0	-	1	0	2	16
1.029	-	555.2	-	1	1	0	15
1.030		574.4	-	1	1	1	14
1.031		593.6	-	1	1	2	13
1.032	-	612.8	-	1	2	0	12
1.033	-	632.0	-	1	2	1	12
1.034	-	651.2	-	1	2	2	11
1.035	-	670.4	-	1	3	0	10
1.036	-	689.6	-	1	3	1	9
1.037	-	708.8	-	1	3	2	8
1.038	-	728.0	-	1	4	0	8
1.039	-	747.2	-	1	4	1	7
1.040	-	766.4	-	1	4	2	6
1.041	-	785.6	-	1	5	0	5
1.042	-	804.8	-	1	5	1	4
1.043	-	824.0	-	1	5	2	3
1.044	-	843.2	-	1	6	0	3
1.045	-	862.4	-	1	6	1	2
1.046	-	881.6	-	1	6	2	1
1.047	-	900.8	-	1	7	0	0
1.048	-	920.0	-	1	7	1	0
1.049	-	939.2	-	1	7	1	19
1.050	-	958.4	-	1	7	2	18

* Appendix to Rollo on Diabetes, 2d ed. page 19.

Thus the density of diabetic urine being given, we can, by a simple calculation, ascertain with considerable precision the quantity of solid matter voided by a diabetic patient in a given time. Suppose, for example, as in the case of Fraser, the specific gravity to be 1.040, and the quantity passed in twenty-four hours to be 36 pints, as it was in this instance, it follows that the urine will contain $36 \times 1 \cdot 4 \quad 2 \cdot 6 = 44 \cdot 3 \cdot 1$ 16, or more than three pounds and a half of solid extract.

For determining the specific gravity of diabetic urine, the “thousand grain bottle” is better adapted than the *uranometer*, since the stems of the latter in general use are not graduated higher than 1.060.

c. Chemical characters.—The great characteristic of diabetes is the presence of saccharine matter in the urine. The saline contents are diminished in quantity, and albumen and oil are occasionally found.

a. Sugar.—The sugar found in diabetic urine is of two kinds, viz. *crystallizable* and *uncrystallizable*, and may be detected by the taste, alcohol, nitric acid, or by the process of fermentation with yeast.

The *taste* is by no means a certain test of the presence of sugar in the urine, for if the salts should be abundant, the saccharine taste is covered. The experiment may be tried in a familiar but convincing method, by making an artificial mixture of sugar and salt. Vauquelin notices cases in which, although the urine contained sugar, no saccharine taste was perceptible,—a fact which Dr Christison states that he has verified in two instances.

Alcohol is a more certain test. If diabetic urine be evaporated till it ceases to lose weight, a solid extract is obtained, and if to this cold strong alcohol be added, the uncrystallizable sugar is taken up, but it does not dissolve the crystallizable. Hot alcohol, in the next place, is to be added, which takes up the latter, and if the solution be slowly evaporated, this crystallizes in small granular crystals. To obtain it, however, in this state, is by no means an easy matter,—as it has often eluded the research of the best pathological chemists; and I am therefore less unwilling to confess, that I have

never obtained it in this condition. The difficulty in the process is one not easily surmounted, since it has been satisfactorily ascertained that the admixture of a very small proportion of the uncrystallizable with the crystallizable sugar will most certainly prevent the crystallization of the latter. Most generally, therefore, only a thick syrupy extract is obtained, which, when charred, has the odour and taste of burnt sugar.

Nitric Acid.—On adding nitric acid to urine containing sugar, oxalic acid is formed, and this being thrown down by lime, the quantity of sugar may be ascertained.

Fermentation.—By far the best mode, however, of detecting the presence of sugar in the urine, and determining its proportion with accuracy, is the process of fermentation with yeast; no other substance in this fluid can be subjected to this process,—none of its natural ingredients can undergo the vinous fermentation when mixed with yeast. During the process of fermentation, the gas disengaged is collected under mercury, and every cubic inch of carbonic acid indicates one grain of sugar.

β. Salts.—Diabetic urine is defective in saline contents, which are sometimes diminished to the extent of one-third of their usual amount. In the experiments of Nicolas and Guendeville, made in 1803, on diabetic urine, no traces of sulphates or of phosphates could be detected.

γ. Albumen.—Occasionally the urine is coagulable—a fact which Cotunnius† was one of the first to mention. This, of course, indicates disease of the kidney. I have observed a case in which it contained blood.

δ. Oil has been mentioned by authors to be occasionally present in diabetic urine. Dr Satterly,‡ among others, notices a case in which, when the urine was first voided, very minute globules of an unctuous substance were seen floating in it, which, as it cooled, collected in large quantities at the surface. In the eighth case which I have noticed, this appearance, I believe, was observed. The presence of oil in diabetic urine

* Vide Note A. † Med. Trans. of the College of Physicians, Vol. v. p. 4.

has been supposed to indicate defective powers of assimilation. It may be detected by sulphuric ether.

Urea and *lithic acid* have been stated to be defective in diabetic urine. The former principle, Dr Henry mentions, is very deficient indeed; and Cruickshank, * Dalton, † Fourcroy ‡ Nicolas, Guendeville, § and Thenard, have been led to conclude that urea is not contained in any proportion whatever in diabetic urine, or is entirely absent.

Dr Henry observes, that the proportion which it contains sometimes does not exceed one-fortieth or one-sixtieth of that which is present in healthy urine, although he is of opinion that it must contain a certain proportion of this principle, from noticing the phenomena attending its spontaneous decomposition.

Dr Bostock || also, although he once entertained the opinion that this principle is defective in diabetic urine, was afterwards, by further experiments, inclined to admit the absence of urea.

To these great authorities I oppose the observations of Mr Kane, ¶ Dr Christison, ** Mr M'Gregor, †† and Dr Maitland, ‡‡ who have shown that, so far from being deficient, it is frequently in its usual proportion. The fact of urea being decomposed at 112° and being resolved into carbonate of ammonia, is a circumstance which seems to have been overlooked by those chemists who have denied its presence in diabetic urine, and from not having used precautions to guard against this occurrence, they have necessarily failed in detecting it.

Mr Kane, from several analyses of diabetic urine, has finally been led to the conclusion that, in this disease, the urea is not at all diminished in quantity, but “ that a man secretes in a

* Appendix to Rollo on Diabetes, *passim*.

† Bardsley's Medical Reports, p. 161.

‡ Systeme des Connais. Chim. 4to. v. 480.

§ Annales de Chimie, lix. 48.

|| Medical Memoirs, p. 260.

¶ Dublin Journ. of Med. and Chem. Science, i. p. 17.

** Clinical Lecture on Diabetes, February 19th 1838.

†† An Experimental Inquiry into the Comparative State of Urea in Healthy and Diseased Urine, and the seat of the formation of Sugar in Diabetes mellitus. 1836.

‡‡ Experimental Essay on the Physiology of the Blood.

given time as much of that principle while dying of the most severe saccharine diabetes, as he does in a state of the most perfect health."

Urine sp. gr. 1.0505. Quantity 10 pints.

Water,	.	880.5
Sugar,	. .	70
Urea,	. .	13.5
Albumen,	.	3
Salts, &c. and loss,		33

1000

In four other analyses the proportion detected was 9 : 9.5 : 6.5, and 5.3 parts of urea per 1000, and the quantities of urea given were actually found, and were less than existed in the urine.

Dr Christison exhibited at the close of the clinical lecture referred to a specimen of diabetic urine, * which had previously been evaporated to one-twelfth of its original weight, and, on the addition of nitric acid to this concentrated portion, crystals of nitrate of urea formed gradually, and in great abundance, on the sides of the vessel. The quantity employed was ℥vi. evaporated to ℥ss.

Mr Macgregor of Glasgow,† who estimates the average amount of urea secreted in health at about 360 grains daily, has found as much as 1013 grains, and more lately Dr Maitland has obtained 667 grains daily from diabetic urine. I have obtained numerous crystals of nitrate of urea from diabetic urine, by attending to the directions given by Dr Christison.

The urea, then, so far from being defective, is frequently very *abundant*, and it is from the fact already mentioned, and also from the presence of sugar, which prevents the formation of nitrate of urea in any quantity, that its deficiency or absence has been inferred.

Lithic acid has also been stated by some chemists to be defective, or rather absent, in diabetic urine; and M. Andral ‡

* Stevenson's Case.

† Op. citat.

‡ Précis d'Anatomie Pathologique, Tome deuxième, p. 658.

is of opinion, that one of its chemical characters is much more frequently the absence of uric acid than that of urea.

I have already stated in a former part of this essay, that its absence depends merely upon the diluted state of the urine. This may also account for the opinion entertained by some chemists, viz. that the salts are diminished; for Mr Kane is of opinion that they exist in their natural proportions. I believe, however, that the saline contents are actually diminished as I have stated.

ETIOLOGY.—The two principal theories which have been adopted with regard to the proximate cause of this disease are, *first*, that which ascribes it to *defective powers of assimilation*, an opinion entertained by Dobson,* Cullen,† Home,‡ and Rollo;§ and, *2dly*, that which places its seat in the kidney, which Dr Cawley has supposed to be the case. Without entering upon the consideration of the different doctrines which have been stated, the best account of which is to be found in Dr Rollo's celebrated treatise, I shall merely endeavour to show that the opinion originated by Dobson is the most plausible,—an opinion confirmed as it is by the circumstance that sugar exists in the blood of diabetic patients.

Wollaston endeavoured without success to detect its presence in that fluid; and Vauquelin and M. Ségalas could not discover it in the blood of a woman affected with this disease, whose urine contained 1 in 7 parts of sugar. More recently, however, this interesting subject has been taken up by Felix Ambrosiani of Milan, who procured it in the crystalline form, and also obtained a syrup, which was capable of fermentation with yeast; and about the same time, Dr Charles Maitland,|| without being aware of the discovery, succeeded in obtaining sugar from diabetic blood, that is to say, he pro-

* Med. Obs. and Inquiries, Vol. v.

† First Lines of the Practice of Physic.

‡ Clinical Obs. and Experiments, p. 319, 1784.

§ Op. citat.

|| Medical Gazette, Vol. xvii. for February 1836.

cured a substance possessing a sweet taste, and having the odour of burnt sugar. With regard to the experiments of the former, there cannot be the least doubt, since sugar was detected chemically in this fluid, and the accuracy of the observations of the latter gentleman cannot be questioned.

During the present winter the blood of a well marked case of diabetes was subjected to analysis by Dr Maitland, but did not yield any sugar either by the process of fermentation, or on the application of the other tests. The case was that of Thomas Smith, to which we have previously referred. Mr Henry Madden tried the experiment with a similar result. In conclusion, it may be mentioned that Mr M'Gregor has lately put this subject in a very clear point of view, for he has traced the sugar from the stomach to the secretions.

“ Sugar is formed in the stomach of healthy individuals after a meal of vegetable food ; but not after animal substances have been taken. It may occasionally be found in the blood of healthy individuals, though in very small quantities. At present it has not been detected in healthy urine.

“ In diabetes the same takes place, though to a much greater extent, and less in dependence upon the quality of the food. A diabetic patient being made to vomit, and fed upon roast beef and water for three days, was again subjected to the action of the emetic, and the matter thus vomited fermented briskly with yeast. The experiment was repeated on the same and another patient, with a similar result.” *

Sugar was also obtained from the saliva of diabetic persons, though not from their sweat. The breath of diabetic patients I have observed to exhale a distinct saccharine or alcoholic odour, which was very well marked in the case of Stevenson.

Yeast administered by M'Gregor to diabetic persons after a meal, had to be discontinued, because, to use their own expression, they were, “ on the eve of being blown up.” Sugar was also obtained from the stools when quite free of urine.

* Maitland on the Physiology of the Blood, page 89. Prize Thesis, 1838.

Among the predisposing causes of this complaint, indulgence in spirituous liquors, exposure to cold and wet, the immoderate use of acid drinks (such as sour butter-milk and whey,) excessive labour joined to hard fare, and the depressing passions, are the most frequent.* The disease, however, occurs in persons whose sobriety cannot be questioned, and who do not make use of acid beverages, and in individuals leading a sedentary life, although no doubt the lower orders are more subject to it than the higher classes of society. The disease is certainly hereditary,—examples of which have occurred in the practice of Dr Alison, where three generations, if I mistake not, are mentioned to have been affected with this complaint. Males are more liable to the disease than females, as will at once appear on consulting the recorded cases of diabetes.

DIAGNOSIS.—The increased specific gravity and the increased quantity of the urine, serve to distinguish the disease from every other urinary complaint with which it might or has been confounded; but the presence of sugar is the great characteristic of the disease. Whenever the density of the urine is found to be high, above 1.030, for instance, and while the quantity has been observed at the same time to be considerably above the healthy average, 120 ounces, for example, the existence of genuine diabetes may be with certainty assumed. The only disease it has been confounded with is, as has been before stated, diuresis, but enough has already been said on this subject in a former part of this essay.

PROGNOSIS.—The prognosis may be regarded as favourable when the density of the urine falls, indicating, as it does, a diminution of the solid constituents, especially of the sugar. It is also favourable when the quantity diminishes, or when it becomes more urinous or putrescible, showing a return, or rather increase of the proportion of urea. It may also be considered favourable if the primary disease is not accompanied by any secondary affections. The prognosis is unfavourable

* Med. Reports of Cases and Experiments by Dr Bardsley, Sen. p. 170, 1807.

when the density of the urine rises at the same time that its quantity increases. When secondary complaints co-exist with the primary disease, the prognosis becomes unfavourable. If pulmonic symptoms supervene, the chance of cure, it is hardly necessary to state, is much diminished; and if phthisis, which is one of the most frequent intercurrent affections, should appear, the case is untractable.

When treatment is had recourse to early, (which, however, is seldom the case, since the person affected only applies for advice in most cases after the disease is fully established,) diabetes has been cured, as far as that is possible. The patient has been restored to comparatively good health, the saccharine impregnation of the urine has been removed,* while its quantity has returned to the healthy average. The case is different if there be any secondary affections. In general, however, in the cases met with in an infirmary, the future state of the patient is quite unknown to us, and, therefore, the previous remark does not apply to these instances.

TREATMENT.—However much practitioners may differ with regard to the etiology or pathology of diabetes, there exists no discrepancy of opinion as to its mode of treatment, all agreeing in this point, viz. that an azotized diet is the best. The efficacy of the conjoint employment of *animal diet*, *opium*, and the *warm* bath appears now to be fully established. The first plan of treatment, introduced by Home, and followed up by Rollo and subsequent authors, was given with the idea of preventing the formation of sugar, by the abstraction of vegetable food, and of establishing a more perfect assimilation throughout the whole system. To Dr Rollo, however, belongs the merit of having renewed a practice which had fallen into disuse, and would probably have sunk into entire oblivion, had not he, by the publication and extended circulation of Captain Meredith's case, roused the attention of practitioners to the subject, and enabled them to form more correct notions of the nature and treatment of diabetes. When the use of animal diet is rigidly adhered to, the quantity of

* For Cases, vid. Ferriar's Medical Histories and Reflections, Vol. iv.

the urinary discharge diminishes, and its specific gravity decreases. These points were most strikingly illustrated in the cases of Stevenson and Hannay, the quantity of urine amounting at the period of admission to 624, and a day previous to her dismissal 120 ounces. In the case of Stevenson, the quantity of urine at the period of admission amounted to 448, while the density was 1.0395, but the day previous to dismissal to 138 ounces, and its density 1.035.

In an hospital, it is with very great difficulty for the physician to enforce this plan, since a diabetic patient very soon evinces a relish for vegetable diet.

Opium is given to allay irritability, and its employment is also attended very generally with marked benefit. It exerts an influence both on the quantity and quality of the urine. As the remedy is persevered in, the urine, which on its first exhibition increases in density, acquires its original specific gravity, and even becomes lighter. The quantity of sugar is diminished, and that of urea much increased, sometimes even becoming greater than natural. Lithic acid makes its appearance often in abundance, and the urine acquires altogether a more natural colour and appearance, and is rendered much less prone to undergo the vinous fermentation.*

Diaphoretics, especially immersion in the warm-bath, aided by flannel clothing, is calculated to prove highly advantageous. "It is in this quarter," says Dr Watt, "that the first impression on the disease is usually made; and we have no security of the system being fully restored till the skin becomes natural in its appearance, and resumes its functions."†

Venesection is employed at the commencement of the disease if the pulse admit of it, and has some effect both on the quantity and quality of the urine. Blood-letting, animal diet, and opium may also be employed in conjunction, as suggested by Dr Elliotson; but Dr Lomax Bardsley prefers the warm-bath to venesection in this affection. The warm-bath I have seen tried with some degree of success by the physicians of the Royal Infirmary; even the day after its exhibition, the quantity of urine was in generally material diminished.

* Prout, op. antea citat, p. 76.

† Op. citat. p. 222.

It would be needless to mention every remedy that has been employed in this disease; for I should then have to run through the greater portion of the *Materia Medica*. I may state, however, that tonics, especially iron, have been used.

Diuretics are of course contraindicated.

PATHOLOGY.—The most usual morbid appearance found on dissection is hypertrophy and flabbiness of the kidneys. These glands sometimes exhibit granular disorganization, (for the urine is occasionally coagulable in diabetes;) but this is not connected with the primary disease, in whatever that may consist. Sometimes, however, the kidneys show no alteration of structure, so that the seat of the disease cannot be referred to these organs. The mesenteric glands have been observed to be large, and tubercles and cavities in the pulmonary tissue are mentioned as being among the most frequent morbid appearances; but the latter are to be regarded merely in the light of accidental affections; and it is, on the whole, probable, that the proximate cause of diabetes consists in a defective assimilating process, being strictly functional, and not essentially connected with the morbid lesion of any particular organ.

2. *Nitric Acid.*

Of the presence of this acid in the urine I have already spoken in a former part of this essay.*

3. *Purpuric Acid.*

The existence of this acid in the urine, as indicating disease, has also been discussed.†

4. *Uro-benzoic Acid.*

Benzoic acid was discovered in the urine of the cow by Rouelle, and has since been detected in the urine of children. Liebig, however, considers this as a distinct acid from the benzoic, as its salts are less soluble in water, and it contains nitrogen, which the benzoic does not, being an oxide of an hydro-carbonous body, to which the name of benzule has been

* Vide p. 20.

† Idem. et. seq.

applied. Liebig names it hippuric, as he considers it peculiar to the urine of the horse, and Berzelius uro-benzoic, from its composition. Scheele also detected benzoic acid in the urine of infants. It can be obtained by evaporating the urine nearly to the consistence of syrup, and adding hydrochloric acid. The precipitate, consisting of uric and benzoic acids, is digested in alcohol, which dissolves the benzoic acid.*

5. *Carbonic Acid.*

Notwithstanding the statement of Mr Brande, that this acid exists in healthy urine, I am inclined to doubt it, not only because my own experiments have failed to detect it, but because Berzelius positively asserts that it is not to be found. That it exists, however, in some cases of derangement of the urinary secretion is probable, since Dr Prout states that he has seen small calculi discharged from the bladder composed principally of the carbonate of lime.† Dr Marcet thinks it probable, that, under certain circumstances, it may exist in disease.

6. *Oxalic Acid.*

Whether this acid is secreted in a free state or not, is a point not easily determined, as it always occurs in combination with lime, and, from its great affinity for that earth, it may be supposed to be derived from the urine. The *oxalate of lime* sometimes forms gravel, and not unfrequently calculi.

7. *Xanthic Oxide.*

This, like the oxalic acid, is placed in this section, although the consideration of both belongs more strictly to urinary calculi. It derives its name from its property of yielding a lemon *yellow* colour ($\xiανθός$, flavus,) when treated with nitric acid,—a property by which it is distinguished. It is stated to resemble the lithic acid very closely in its properties. It constitutes the chief bulk of a small renal calculus, and has only been observed in the urine in one instance.

* Prout, op. citat, p 19.

† Ibid. p. 159, ed. 1.

8. *Cystine.*

Cystine, discovered by Dr Wollaston, enters like the two former principles, into the formation of the cystic oxide calculus, and, therefore, cannot properly be considered here.

b. *Principles introduced from without.*

Derangements caused by the introduction of certain substances, whether in the form of aliments or medicines.

a. *Aliments.*

Many substances upon which man subsists, or which may have been absorbed by the skin, when they can serve no purpose in the animal economy, are eliminated by the kidneys, and may be detected in the urine. Although their presence in this fluid can hardly be said to constitute a morbid condition, still they may in some instances be the precursors of disease.

Citric, Malic, and Tartaric Acids.

The urine is rendered strongly alkaline by the use of certain kinds of fruit, which contain the citrate and malate of potassa, as some of the *Pomaceæ*, and their employment has hence been found to be useful in preventing the formation of the lithic acid calculus. These three acids united with lime have been observed to constitute urinary deposits when the renal secretion holds albumen in solution. In such cases, on the application of heat, the turbid urine first becomes clear and afterwards an opalescence is produced by the coagulation of the albuminous matter.

The salts of lime now mentioned are reduced to carbonates by a red heat. The citrate of lime is distinguished by the following characters: When boiled with a solution of carbonate of potash, carbonate of lime is deposited, and the citric acid forms citrate of potash with the alkali present. The alkaline citrate forms a precipitate with neutral nitrate of lead. Citrate of lead is distinguished by its solubility in a solution of caustic ammonia. Tartrate of lime is known by the cha-

racteristic odour of tartaric acid, which it evolves when subjected to a charring heat.

Malate of lime, like the citrate, forms an alkaline salt when boiled with a solution of carbonate of potash; but the precipitate obtained by the addition of neutral nitrate of lead is distinguished from the citrate of lead, by not being soluble in ammonia, by being very soluble in boiling water, and crystallizing in fine needle-shaped crystals as the water cools.*

I have noticed only these three acids, because they have been observed to form urinary sediments; but besides these a great variety of other principles may pass from the stomach into the urine.

From the accurate experiments of Wöhler† and Stehberger,‡ it appears that all substances which are soluble in the animal fluids, and which are neither assimilated, decomposed, changed into an insoluble substance by any of the vital processes, nor destroyed by respiration or other chemical actions of the system, which do not act in a manner too powerfully astringent, and which are not sufficiently volatile to escape by cutaneous or pulmonary absorption, may pass from the stomach into the urine, whether the ingesta consist of alimentary or medicinal agents. Some appear in the renal secretion unchanged.

β. Medicinal Agents.

1. Simples.

Iodine may be detected in the urine of those who have taken it internally, or who have applied it to the skin in the form of ointment, or in the state of an hydriodate. Mr Rees detected it in the urine of an individual who had taken only one grain, and that in three separate doses of one-third of a grain each.§ Dr Madden|| succeeded in ascertaining its pre-

* Rees on the Blood and Urine. 1836. P. 146.

† Zeitschrift für die Physiologie, Heft. 2, 1825.

‡ Ibid. Band 2, Heft. 2.

§ Rees, op. citat, page 19.

|| Experimental Inquiry into the Physiology of Cutaneous Absorption, 1838, p. 103.

sence in the urine after having immersed his arm, during the space of forty minutes, in a tepid solution of an ounce of the hydriodate of potash. It may be detected in a very simple manner by mixing the urine with about one-eighth part of strong sulphuric acid, and then suspending over the containing vessel, a piece of bibulous paper saturated with a solution of starch. The iodine rises in vapour, and, combining with the starch, forms a deep blue, so characteristic of its presence in a free state. It may also be tested by sulphuretted hydrogen, which converts it into hydriodic acid.

Chlorine has also been detected in the urine, which in these cases loses the property of reddening litmus paper. It is distinguished by the property it possesses of destroying vegetable colours.

2. *Metals.*

Mercury.—Cantu* asserts that he has succeeded in detecting the presence of this metal in the urine of persons who had used it in the form of ointment. The fluid, in such cases, is alkaline, and yields a deposit on cooling, which, when dried, and mixed with finely powdered charcoal, yields on sublimation, globules of metallic mercury.

Iron.—The urine of persons taking a large quantity of the preparations of this metal becomes of a bluish colour, on the addition of a few drops of a solution of ferrocyanate of potassa.†

3. *Neutral Salts.*

Among the saline compounds, the carbonate, chlorate, nitrate, and sulphate of potash, the borate of soda, the muriate of baryta, and the ferrocyanate of potash, were found by Wöhler to pass from the stomach into the urine unchanged. Although out of order, it may be stated that *urea* does the same. When taken into the stomach, it speedily reaches the bladder, from

* Annales de Chim. et. de. Phys. xxvii. 335.

† Berzelius, op. cit. p. 400.

its stimulating the kidneys.* Potash, taken into the stomach, as a hydro-sulphuret, was found in the urine partly in that state, and partly changed into the sulphate. The tartrates, citrates, malates, acetates of potash and of soda are found in the urine converted into carbonates of these alkalis; the acids having undergone decomposition during their passage from the stomach to the kidneys. On the contrary, if these vegetable acids be taken into the stomach in a free state, they do not suffer decomposition, but are found in the urine united with an alkali. After using the oxalic or tartaric acids, the urine on cooling deposits a crystalline white powder, consisting, as the case may be, of the oxalate or tartrate of lime. The addition of muriate of lime to the urine increases the quantity of these precipitates. Tartaric acid appears to render the urine highly acid.

5. *Acids.*

Nitro-muriatic.—The urine of individuals using this acid acquires the peculiar property of destroying vegetable colours.

I have already twice alluded to the presence of nitric acid in the urine, and shall on the present occasion only state that, when exhibited internally, it renders the urine strongly acid.

Succinic.—This acid when given internally has been detected by Wöhler in the urine of man and dogs.

Hydrocyanic.—It is exceedingly improbable that prussic acid has been found in the urine, since it undergoes decomposition long before it arrives at the kidneys, and yet some authors have stated that they have detected it.

5. *Vegetable Colouring Principles.*

The urine frequently exhibits the colour of the various matters taken into the stomach; and the examiner must be on his guard against being deceived by such appearances. Thus, Mr Rees mentions a case of a person treated for *hæmaturia*, for eight or ten days, during which he had been eating a

* Ségalas, Journ. de Physiologie Experimentale, 1822.

sallad, partly composed of beet root, the colouring principle of which had tinged the urine. The urine has also been observed to be rendered brown during the use of the *Pyrola umbellata*.

These vegetable colouring matters are easily distinguished by adding a solution of caustic potash to the urine, when a green colour is produced, which is destroyed on supersaturating the acid with an alkali.

Alizurine.—The characteristic colour which the *Rubia tinctorum* imparts to the urine, either when taken internally, or applied to the skin, is familiar to all.

Rhabarbarine.—This vegetable colouring principle may, like the former, be detected in the urine of persons who have used it internally, or applied it to the skin. The test recommended for its detection is the *aqua potassæ*, which is not very delicate.

Indigo.—This colouring principle exists in the urine of those taking it internally. My friend, Dr Craigie, informs me that he detected its presence, not chemically, as this was not necessary, (since it strikes with fluids a colour which cannot be mistaken,) not only in the urine, but also in the blood of an epileptic, to whom this medicine had been administered.

Hæmatoxyline or *Hæmatine*.—The colouring principle of the *Hæmatoxylon campechianum* also imparts to the urine a very characteristic deep red tint.

Other colouring principles might be mentioned which enter this secretion ; but, as the consideration of these is not very interesting in a pathological, whatever it may be in a physiological point of view, I shall not enter into it at present.

Some colouring principles, as cochineal and litmus, do not pass from the stomach into the urine, being probably decomposed during the processes of assimilation.

6. Colouring Principles probably Animalized.

Cyanurine.—This term has been applied by Braconnot to the *blue sediment*. It can hardly be said to have been observ-

ed in connection with any particular form of disease. Garnier and Delens found that this blue colouring matter was not changed on the addition either of alkalis or acids, except nitric acid, which destroyed its colour.

When heated this precipitate yields carbonate of ammonia and empyreumatic oil. It is slightly soluble in water and boiling alcohol. The alcoholic solution is green, and on cooling deposits a dark blue powder, of a semicrystalline appearance. On evaporating the alcohol, the blue colouring matter may be dissolved in acids, and the only residue is a small quantity of fatty matter. All acids dissolve and redden it. When dissolved in dilute sulphuric acid and evaporated to dryness, it yields a fine carmine colour. This becomes brown by solution in water, but resumes its former tint on evaporation to dryness. When the red acid solutions of this colouring matter are neutralized with an alkali, the original blue colour is restored, and a precipitate is formed. This blue colouring principle is very little if at all soluble either in potassa or its carbonate. Braconnot further observes that this substance is entirely devoid of taste or smell, and darker than Prussian blue.* Mr Rees supposes that it may be owing to the presence of some vegetable principle, more or less modified (perhaps animalized) by passing through the kidneys.†

Melanic Acid.—Dr Prout has applied this term to the black colouring matter sometimes found in urine. Dr Marcet notices the case of a child whose urine did not contain either uric acid or urea, and the colour of which was sometimes as black as ink. When treated with an acid it does not at first undergo any appreciable change, but after a time deposits a number of black flocculi, and becomes clearer. This black precipitate is insoluble in water and alcohol; but soluble in the sulphuric and nitric acids, acquiring a black tinge. It may be precipitated from its acid solutions without undergoing any material change. It is soluble in the caustic and carbonated alkalines, from which it may be precipitated by acids. With the metallic oxides it forms insoluble compounds

* Berzelius, op. cit. p.405

† Op. citat, p. 80.

of a brown colour. Dr Prout from his experiments considers it a weak acid. Berzelius states that it very much resembles the pulverulent black substance insoluble in alcohol, procured from the constituent extractive principles of the urine on the addition of concentrated acids. Hence this black colouring matter described by Dr Marcet may have resulted from some marked change taking place in the organic matter, which imparts to the urine its peculiar colour in the normal state.

These two colouring matters, more particularly the last, do not belong to the class of alimentary or medicinal substances, but to that of principles generated in the system. For the sake of convenience, however, I have introduced them here.

7. *Odoriferous Principles.*

The number of odorous principles passing into the urine are numerous. The effect produced on that secretion by eating asparagus, and by taking oil of turpentine into the stomach or even by inhaling its vapour, is the subject of daily observation. *Oleum Juniperi*, the *Oleum Valerianæ*, and the *Oleum Allii* impart to the urine each its peculiar odorous principle. The same is true respecting *castoreum*, and the *narcotic principle of opium*.

The transmissible quality of the *Agaricus muscarius* has also been observed.

8. *Alcohol.*

Dr Percy informs me that he has more than once detected the presence of alcohol in the urine of dogs to whom it had been given. This is contrary to the opinion of Berzelius; but from the accuracy of Dr Percy's experiments, and the minute attention which he has paid to the subject, I place complete confidence in his results.

IV. MORBID CONDITIONS OF THE URINE ARISING FROM SUBSTANCES MINGLING WITH IT BETWEEN THE PERIOD OF ITS SECRETION AND THAT OF ITS EXCRETION.

1. *Pus.*

Many writers have denied that pus has been detected in the urine in disease, under any circumstances. The presence of purulent deposits in the urine is very important, leading us to suspect a very serious morbid condition of the kidney, urinary passages, or bladder, if not positive disorganization of some one or more of these structures. The difficulty of distinguishing very small quantities of pus from equally minute proportions of mucus has long been universally acknowledged; but in most cases in which it is met with in the urine, it is in sufficient quantity to enable us to recognize it without much difficulty, both by its physical and chemical characters.

Urine containing pus is almost invariably of a pale colour. Sometimes, however, it is acid, at other times alkaline. If urine of this character be allowed to remain at rest for some time, the purulent matter subsides in the form of a substance of a greenish-yellow tint, which is highly characteristic of its presence. It is ropy, and in some cases capable of being drawn out into threads. When thrown upon a filter, it appears as a perfectly opaque coagulum, of a greenish-yellow colour, and very different from the mucus usually found in urine.

The reagents employed for the detection of pus are sulphuric or nitric acid,—the former of which forms with it a solution of a deep brown colour, bordering upon purple. Upon diluting it with water the colour is entirely discharged, and the fluid becomes turbid from the diffusion of opaque particles through it. Mucus is not similarly affected. If pus be boiled with three or four times its bulk of strong nitric acid, a yellow coloured solution is obtained, which on evaporation forms a yellow viscid mass.

Purulent urine is invariably albuminous, as shown by its coagulating by heat and nitric acid. Tincture of galls, cor-

rosive sublimate, or alum, either produce a precipitate or render it turbid.*

Urine containing pus may be distinguished from truly albuminous urine by the following characters :—

Nitric acid dropped upon pus renders the globules somewhat smaller, of a brownish opaque appearance, without disturbing the diffusion of the globules through the fluid in which they are contained. Rectified spirit of wine dropped upon pus disposes in some degree its globules to run together and partially adhere in clusters. The same effect is also produced by a drop of boiling water. These appearances do not occur in those cases in which modifications of albuminous matter appear.†

2. *Hairs.*

The urine has been observed by ancient authors to contain hairs. M. Magendie‡ has recently published some observations on this subject. He found the hairs to be united with a certain proportion of saline matter. M. Andral, in one of the two cases recorded in M. Magendie's work, remarked a great number of fine hairs in the urine, above an inch in length, mixed with a white powder, found on analysis to consist of a large proportion of phosphate of lime, a small quantity of phosphate of magnesia, and slight traces of uric acid. The first case occurred in an old man, of sober habits, who voided daily so great a quantity of these hairs, as to fill in a few days boxes capable of containing a French pint. In the second, M. Magendie states that the patient, along with his urine, voided concretions, covered superficially with hairs.

I have now considered all the pathological conditions of the urinary secretion, with the exception of calculi. Into this, however, I shall not enter, as it would extend my paper to too great a length. I shall devote the few remaining pages to a report of some cases of Bright's Disease of the Kidney,—a subject which is intimately connected with the topics discussed in the preceding pages.

* Brett, *op. citat.* p. 924.

† Howship, *op. cit.* p. 69.

‡ *Recherches sur la Gravelle*, 2d ed.

Note A. to Page 30.

“ Nam duabus libris ejus urinæ ad ignem admotis, cum pene dimidium evaporasset, reliquum facessit albam in massam, tenerrimo jam coacto ovi albumine persimilem. Neque tantum in auctis hydropicum urinis, sed in illis etiam, quas excreverint diabete correpti, hanc urinæ naturam coaguli materiam ad ignem exhibentem, quamquam non adeo insignem, pari tentamine non semel comperimus. Primum itaque constat, urinas quas, in sanis nemo coagulabiles invenerit, quandoque posse coaguli materiam contineri.”*

* Cotunnus de Ischiade Nervosa, Comment. Neapol. 1764, cap. xvii. p. 417, ext. in Thesaur. Eduard. Sandifort. Rotterdam, 1769.

Page 8, line 10, *for* spontaneous, *read* instantaneous.

Page 9, Table, *for* spontaneously, *read* instantaneously.

Page 64, note, *for* Tom. xxi. *read* Tom. ii.

